

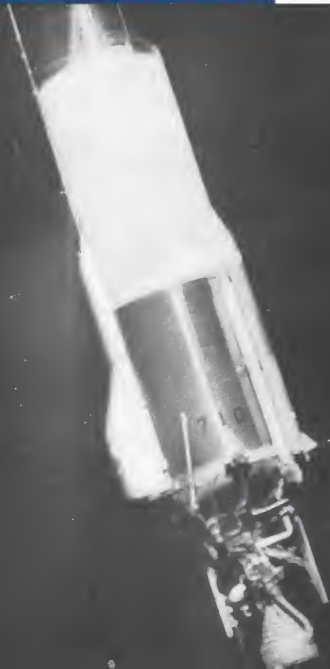
November 14, 1960

# Aviation Week

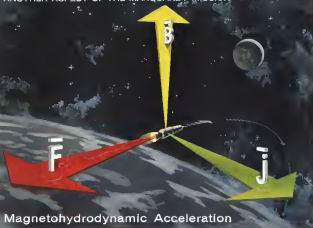
and *Space Technology*

**B-58A 'Airliner'**  
**Proposed to Gain**  
**Supersonic Data**

Convair Atlas  
At 250-mi. Altitude



ANOTHER ASPECT OF THE MARQUARDT MISSION



## Magnetohydrodynamic Acceleration

Preliminary investigation by ASTRO, Marquardt's division for research into the space-age, indicates that the magnetohydrodynamic rocket offers unique and attractive performance characteristics. For example, once placed in a low altitude satellite orbit, this device can compensate for air drag or change the orbit position—all without the expenditure of propellant. The energy is supplied by a water-electric power system which accelerates the captured air by steady magnetohydrodynamic (jxB) forces thus producing the propulsive force.

The accelerator of the MHD rocket works in much the same way as an electric motor. A steady electric current (j) is passed through a conductor (ionized air) in the presence of a magnetic field (B). This combination of fields creates a magnetohydrodynamic body force (F) on the ionized air which drives it to high velocity.

Another important application of the MHD accelerator is to the electrical rocket for use in an extra-terrestrial environment.

In this application the propellant is worked from a tank and heated by an electric arc before passing to the magnetohydrodynamic accelerator.

ASTRO's continuing studies of magnetohydrodynamic accelerators typify but one aspect of The Marquardt Mission.

Create engineers and scientists needed

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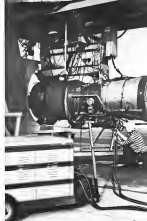
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## CAPABILITY is spelled h-y-d-r-a-u-l-i-c s-t-a-r-t-i-n-g

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Dual-purpose units developed by Vickers as an outgrowth of pioneering work in hydraulic starting offer further benefits in weight saving. These units are used as a motor in engine starting, as a pump to supply accessory power during normal operation. Reduced cost and ground support requirements plus increased versatility and simpler needs after operation are other major benefits. Write for Bulletin A-8001.



**PROVED PERFORMANCE** of hydraulic starting for jet engines is demonstrated by the fact that has performed more than 3,500 trouble-free starts in a 2-year period. Cost low is due to ruggedly constructed of three different alloys. Prime mover never required is only 25% of that needed for other starting methods due to inherent high efficiency of the hydraulic technique.



**JET PROP STARTING** compression uses engine-mounted starter motor and provides own power supply. Starter output speed of approximately 3,000 rpm was achieved in 34.8 to 40 seconds during series of observed test starts.

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## Beyond All Others...



## Here's Why Silastic Is Used In Man's Probes Into Space!

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Engineers of Rocket Motors Division of Thiokol Chemical Corporation specified an accelerometer diaphragm of Silastic L5 for the X-15's XLR-49 engine. The accelerometer provides oil at a constant pressure to the fuel all jump. Gasoline strikes under pressure is the source of stored energy, and is separated from 4-11V Fluorobutyl oil by the Silastic L5.

Here are diaphragm requirements the designers established as essential: An elastomer flexible from —50 to 200°F (Silastic L5 maintains its flexibility from —50 to 500°F); compatible with the oils at low and elevated temperatures (Silastic L5 has little swell or change in dimensions readings after immersion in every hot oil, fuel and some hydrocarbon fluids); will not contaminate fuel oil (Silastic L5 has no plasticizers or additives which can contaminate by leaching).

Silastic L5... the only elastomer to meet all these requirements... helps the X-15 as it breaks on the door to outer space.

Shown below is the XLR-49 rocket engine. The hole of accelerometer in the light weight type... made possible by the diaphragm of Silastic L5... instead of the heavy, bulky piston type. Parts of Silastic can be engineered to meet your specific needs by your rubber fabricator.



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## AVIATION CALENDAR

- Nov. 29—Control Traffic Management Seminar for Army, Navy, Air Force and Marine Corps (cosponsored by the Northwestern Traffic Agency, Arlington Heights, Dallas, Tex.).  
Dec. 5—19th Annual Meeting and 4th Annual Exposition, American Rocket Society, Sheraton Hotel, Washington, D.C.  
Dec. 8-9—Annual Meeting, National Air Turbine Assn., Oklahoma City, Oklahoma City, Okla.  
Dec. 8-11—19th Annual Meeting, National Air Turbine Conference, Oklahoma Sheraton Hotel, Oklahoma City, Okla.  
Dec. 12-14—Aerospace Industry Exhibition, California Museum of Science and Industry, San Francisco, Calif., concurrent with the Atomic Industrial Power's Annual Conference (Piermont Hotel) and the American Nuclear Society's 17th Annual Meeting (Hotel Mark Hopkins).  
Dec. 15-15—Tenth Annual Winter Test Congress Conference, Hotel New York and Manhattan Center, New York, N.Y.  
Dec. 16—Army Aviation District Service Symposium, National Aeronautics Service Assn., Mayflower Hotel, Washington, D.C.  
Dec. 17-18—Wright Brothers Lecture, National History Bldg., Smithsonian Institution, Washington, D.C.  
Dec. 18-19-1776: Visiting American Astronauts for the Advancement of Science, New York, N.Y.  
Dec. 18-19—South East Coast Inter-national Model Fair, West Valley, Pa.  
Dec. 9-11—Seventh National Symposium on Electronics and Quality Control, International Hotel, Philadelphia, Pa.  
Dec. 9-11—International Congress and Exhibition Society of Automotive Engineers (Continued on page 6)

AVIATION WEEK and Space Technology  
November 14, 1960  
Nov. 25, Nov. 26

For many years, major manufacturers have relied on Lavelle for the production of precision sheet metal components. The experience and reputation for quality now provide the modules, chassis, racks and consoles needed to adequately support and house complex electronic systems.

To keep abreast of new developments in parts and assemblies for the aerospace age, Lavelle has acquired new production facilities, with particular attention to the requirements of the electronics industry. Featured above is a Wadsworth RA-41P turret punch press, operated by a Lavelle employee to produce intricately punched sheet metal panels used in modules and housings such as shown.

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electronic / AEROSPACE  
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BY LAVELLE

For many years, major manufacturers have relied on Lavelle for the production of precision sheet metal components. The experience and reputation for quality now provide the modules, chassis, racks and consoles needed to adequately support and house complex electronic systems.

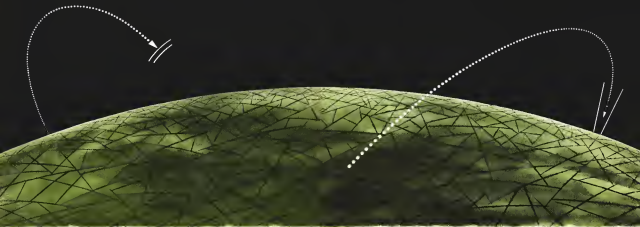
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**DECEPTION...** Studies in enemy missile detection lead to studies in systems for our own missiles to evade detection... Penetration Aids. A ballistic weapon of current configuration cannot take evasive action in the terminal phase. To confuse enemy tracking networks, deception is necessary. What type decoy? What systems are they using to detect and Passive? Active? ... Radar, IR, UV. One of our fields of research is finding means to combat these

detection methods. We are working toward complete missile-missile systems to sense, analyze, intercept, and counter, systems to eliminate as many hazards as possible to insure delivery of the weapon to the target.

If you are a service scientist or engineer interested in helping to solve both sides of the missile equation, write LORAL Electronics Corporation, New York 72, New York.



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## The elements of guidance and control:



**Data Acquisition and Application Subsystems**—IBM has proven capabilities to provide real-time man-to-machine and machine-to-machine elements of weapon guidance systems. In addition to the Bombing/Navigation system with its visual displays in the B-52, IBM also provides interface devices to apply this system to air-launched missile guidance. Federal Systems Division experience in air-based and ground-based guidance systems is proven in operation.

**Radio Communications Subsystems**—The SAGE data processing system, heart of America's air defense network, embodies advanced communications devices and techniques required to filter and direct an enormous flow of data. Designed and built by the Federal Systems Division, the AN/FSQ-7, an advanced system is operational, embodies processing and communications power to direct defense operations as well as to guide missiles from remote sites.

**Data Processing and Control Subsystems**—Now in development, the Advanced Bombing/Navigation and Missile Guidance system is another example of IBM's "closed-loop" systems capability. This system satisfies the operating requirements of high-speed, long-range weapon systems. Compact, reliable equipment such as this and Federal Systems Division's computer for the Titan missile guidance system are the result of IBM's vast background in data processing and control.

## all systems capabilities of IBM

IBM's experience in data processing and data communications, supplemented by an extensive background in data acquisition, adds up to a three-way capability for developing, producing and integrating total automated systems. This capability is being advanced through continuing research in miniature high-speed devices for high-reliability guidance systems of the future.

Federal Systems Division, 326 East Montgomery Avenue, Rockville, Maryland

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Where metal parts must stand the sudden shock of heavy loads, as on plane landing gear... or the high heat of jet engines Midvac Steels offer the answer. The Midvac Process of consumable electrode vacuum melting produces metals with increased tensile, higher impact properties, improved stress rupture strength at elevated temperatures, and longer fatigue life.

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Alloy	Making Process	Yield Strength $\sigma_{20}$	Ultimate Tensile Strength	Tensile Elongation	Percent Reduction of Area
A-354	Air Melt Midvac	91,000 psi 117,000 psi	121,000 psi 190,000 psi	6.8% 11.3%	14.7% 33.9%
6061-C	Air Melt Midvac	234,000 254,200	281,000 314,310	4.0% 2.4%	35.4% 28.4%
Steel	Air Melt Midvac	223,400 254,300	284,300 291,400	5.1% 10.2%	19.7% 25.6%
901 Regular	Midvac	114,000	140,200	16.9%	25.0%
901 Hi-Strength (Alloy)	Midvac	121,000	171,000	16.2%	30.2%

Properties shown are averages of 22 tests.



# Midvac Steels

READY... at General Electric's

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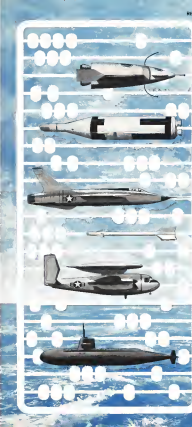
Polaris Submarine Fire Control Computer  
Polaris Missile Guidance Computer  
Skyball Missile Guidance Computer  
W2F-1 Computer-Observer  
Toss Bomb Computer for F-105  
Savannah Missile Launch Computers for F-84 and F-105

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The 'breakthrough' of every nation symbolizes the day-to-day race with obsolescence which challenges our nation and its scientific teams. While many achievements today are being lost, no technological group or organization can rest on its laurels in this highly-competitive and war era.

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To some, the promise inherent in much we explore today may sometimes be hidden in such exotic terminology as magnetohydrodynamics, cryogenics, spin electronics, ion propulsion, plasma physics. In these and other fields, our resolve to bridge the gap between aerial legacy and reduction to practice will expedite the widespread application of these new technologies.

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Government and Industrial Group, Philadelphia 44, Pennsylvania

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November 14, 1960

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 Monday, AEP and AEC

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## SHORTER, SAFER STOPS FOR JETS WITH NEW BFG LIQUID-COOLED BRAKES

The revolutionary liquid-cooled brakes developed by B.F. Goodrich have now been engineered for the Boeing 707-720. With completion of flight tests of the brakes on the 760 prototype, kits for equipping airline 707's for service testing and future certification are now being offered.

Tests show maximum temperatures at the brake lining surfaces are held below 540°F, compared to 2800°F in conventional brakes. With temperature and consequent lining wear greatly reduced, these advantages are realized:

- The aircraft can be stopped in minimum distances without major brake damage. Several maximum-energy stops can be made without lining replacement. No restrictions on frequency of brake applications are required.

- Aircraft availability is increased as maintenance is reduced. In addition to the brake linings, life of axles and other brake components will be increased. Damage to brakes, tires, and landing gear from overheating is eliminated.

In the liquid-cooled brake system, the heat of braking is absorbed by a circulating liquid which is passed through a heat exchanger to remove the heat. Surprisingly, overall weight is no more than that of conventional brakes.

Liquid-cooled brakes, we believe, are the answer to the high energy braking requirements of large aircraft. Your B.F. Goodrich sales representative can give you further information. B.F. Goodrich Aeronautics Division, a division of The B.F. Goodrich Company, Dept. 69P-118, Troy, Ohio.

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## EDITORIAL Supersonic Transport Race

A major program requiring action from an intergovernmental government is required in the effort to develop a supersonic transport. Since President-elect John Kennedy stressed during U.S. prestige abroad, so early in his successful campaign against the "Soviet" as the world's opponent, he should be especially interested in the supersonic transport race, for the program in successful development of a supersonic transport will be a major index of international technical prestige in the final years of his initial administration. Part of which country really wins this race will be only evident to all flags will be of U.S. involvement, with the Concorde 850 and 600 series joining the Boeing 707 series and the Douglas DC-10. The unsatisfactory capacity in the jet age to supply a maintenance of the U.S. tradition of transport manufacturing confidence began in the present era of the DC-10 and maintained in the pasteurized days with Lockheed Constellation, Constellation and Douglas DC-6 and 7.

With this long tradition of superiority in the international transport equipment market, it would indeed be a major blow to U.S. prestige abroad if some other flag flew first on a successful, home-country supersonic transport.

Fortunately, there have been Americans with sufficient technical vision to recognize the importance of a major new transport development. Lockheed, Boeing, Douglas and Concorde have all spent some of their own money and technical resources in exploring this area. General Electric and Pratt & Whitney are developing the common powerplants for this speed range. In the government, men such as John Stuck at the National Aeronautics and Space Administration and E. B. "Pat" Quercia, Federal Aviation Agency administrator, have devoted their efforts to matching the Soviet speed in this technical spectrum. They have also engaged plans for an effective national program to work jointly and efficiently toward keeping the supersonic transport race being a another chapter of U.S. leadership in dependable economic development.

This program developed by FAA proposes to utilize fully the resources of NASA, the Air Force and the leading transport manufacturers in a truly national program. It is obvious from even a preliminary examination of the Russian proposal that they are beyond the resources of any private corporation. This program is now in the White House on President Kennedy's desk, where it will be dealt over to the attention of President-elect Kennedy if he looks carefully for it.

However, there are signs that an intergovernmental supersonic race would be the program during the next regime before Sen. Kennedy formally assumes executive authority. Chief officials in the press appear to be the

Air Force and its shared now operating at the Secretary of Defense office level. It would appear from recent comments and gossip at the White House that USAF, at least under the present administration, would like to keep the supersonic transport project as a strictly military program under its exclusive control.

The course for this position is apparently a feeling that the supersonic transport can be readily hatched from the B-70 Mach 3 bomber program now under way at North American Aviation. We can understand USAF anxiety about military over involvement in developing the B-70 program. It has sought a domestic battle to prevent this important weapon system from being killed by financial starvation during the recent budgetary battle.

However, we think the Air Force position is attempting to pull a national supersonic transport development program under the B-70 bomber blanket is basically unsound. The B-70 program aims at a major state-of-the-art advance in pushing supersonic operational speeds beyond Mach 3, the point to which current technology has already carried military aircraft. Technical history of the transport industry indicates that development of a successful commercial transport design always lags a product distance behind the most advanced military development to take full advantage of its methods and to fully incorporate all of the new knowledge it generates into a dependable and economic machine. For example, 80 years of swept-wing B-47 and B-52 jet experience preceded the Boeing 707's entrance into airline service. It does not seem technically sound to try to bring along a Mach 3 bomber and transport concurrently.

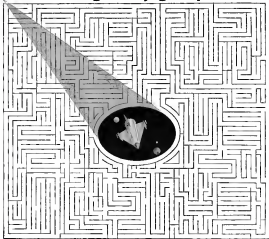
Also, we think it would be a great mistake to make the supersonic transport development program a purely military venture. With all due respect to USAF's technical capability, we do not believe they have the economic perspective to successfully develop a transport that would be operationally attractive to other domestic or foreign airlines. The supersonic transport must be designed and developed with the operating economy of commercial airline operations in clearly paramount from the start as it will be a dismal failure in the international market.

It is already evident that we are in an international technical race to develop the supersonic transport. Britain has designated the British Aircraft Corp. to carry its flag in this race, while the French combine of Sud Aviation and Dassault are working on the same time to plant the tricolor firmly in this field. Soviet designers and politicians have made it clear that they are also working in this area.

We strongly recommend that the new Administration pick up the supersonic transport ball as quickly as possible. It should have a sound working program ready to present to Congress in January, incorporating both military and civil requirements and drawing on all of the best technical resources available. This program should also be vigorously presented next April to the supersonic transport symposium of the International Air Transport Association when the airlines of the world take their first hard look at the subject in Montreal.

—Robert Holt

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## WHO'S WHERE

### In the Front Office

**James T. Donker**, vice president/finance, Fairchild Engine & Airplane Corp., Dayton, Ohio. One day he discussed with New York Airways, Inc., Governor Lammie has engaged as a director of Fairchild but will continue actively as a consultant to the corporation in the development of VTOL/STOL jets.

**Sam Dargo** (Call) operations of Ryan Aeronautical Co. are now assigned to a separate division, the Sam Dargo Division, and Edward G. Galt has been appointed vice president and division manager. Appointed vice president is the late C. A. Bell, former, former; Frank W. Pink, engineering; H. E. Kline, manufacturing; William W. Kline, public and government relations.

**William H. Bailey**, assistant vice president, Nuclear Corporation of America, Detroit, Mich.

**Robert Allen, Otto A. Scherer** (IBM), etc., vice president-marketing, Avco Electronics, Ft. Lauderdale, Fla.

**Charles G. Chelton**, vice president-marketing, Harris Radio Co., division of Union Carbide Corp., New York, N.Y.

**Ray E. Wooten**, vice president and technical director, Lufkin-Walsh Trade Corp., with headquarters in Zurich, Switzerland.

**Thomas O. Matlack**, vice president of administration, Stanley Aviation Corp., Denver, Colo.

**Richard N. Bile**, executive vice president and sales manager, International Air Services Co., San Francisco, Calif.

**L. E. A. Marshall**, vice president, Vice Engineering Co., a division of Vito Corporation of America, New York, N.Y.

**G. M. Ems**, director chief, Material Progress Division, Bureau of Facilities and Material, Federal Aviation Agency, Washington, D.C.

### Honors and Elections

**Dr. Clarence Star** of North American Aviation, Inc., has been elected as Emeritus Member of the Kidde Co., although the total engineering honor society, in recognition of his outstanding leadership in the electrical engineering field.

### Changes

**Dr. Charles F. Soper**, assistant director of research and head of the newly formed scientific laboratory of the United States Division of United Aircraft Corp., Windsor Locks, Conn.

**George L. Davis**, manager Manufacturing program office (AMC) at the Air Force Laboratories at Silverdale Electric Products, Inc., Seattle, N.Y., and Robert D. Gray, technical program manager.

**Robert H. Brown**, general manager to the director, Office of Technical Information and Education, National Aeronautics and Space Administration, Washington.

**Philip Rosen**, design specialist, analysis and space systems engineering, Advanced Design Section, Douglas Aircraft Co., Inc., Santa Monica, Calif.

(Continued on page 349)

## INDUSTRY OBSERVER

► Convair-Aero team will propose a medium-size Apollo vehicle adapted as a readily reconfigured lifting body with an appreciable wing surface. No propulsion will be used during the vehicle's re-entry maneuver, and landing will be planned for a dry lake near Edwards AFB, Calif. Trials led by Convair, General Electric and Martin are conducting Apollo feasibility studies for NASA.

► All Phase is expected to award a \$15-25 million contract for the Dryo-Sort communications-modem test subsystem by mid-December. Representatives of Boeing, the retractor assembly and test contractor, were called by Wright Air Development Division last week to hear a report on a recently completed WADD evaluation of 10 proposals which were requested from Boeing, Collins Radio, GE, IBM, Litton, Motorola, Packard Bell, Philco, RCA and Westinghouse. Weapons Systems Project Office is evaluating several progress proposals from 12 companies, and a decision is expected early next year.

► French are doing bids for a light STOL transport capable of flying 550 mph at 220 mph with a 3,000 lb. payload. There is 550 million committed for the project in the five-year military program. Bidders include Dassault, Breguet and Nord Aviation.

► Bids for electronic programming and test system (APATS) for Lockheed's Orion (developmental orbital transfer) are due today. APATS, estimated to cost \$12 to \$15 million, is the satellite control and control element of the Orion space environment simulator. Bidders include Avco, Electronic Engineering Co. of Calif., Electro-Instruments, Bendix-Precision Division, Natick, Mass., Olin Electronic, Packard Bell, Redstone, Inc., RCA and Verano.

► North American Aviation is studying variations of laminar flow control for application to the Mach 2-5.5 transport which could logically stem from the B-70 Mach 3 bomber development program.

► Proposals for an electronically controlled precision photographic mapping camera, to be used by aircraft at altitudes below 35,000 ft., will be requested soon by WADD. As integrated geodetic and cartographic systems, it will be required to have better accuracy than previously available systems and to deliver actual line measurements faster. Bidders are expected to include such firms as RCA, Lockheed, Convair, Selenia, Motorola, Fairchild Camera and Instrument and Chicago Aerial Industries.

► One top contender in the Project Scout satellite platform competition is RCA's Astro-Electronics Division. Bellvue, Mass. Division received proposals from about a dozen companies to develop the payload for the under-way/astroprobe vehicle.

New Navy mid-air refueling project, PUFFS (Proposed Underwater Fuel-Contingency Feasibility Study), is based on a highly advanced, underway vessel. It is still a study, but Electric Boat Co. and several other companies are developing hardware and some sea trials have been made. System is to be installed on present and future submarines.

► Bidding specifications for the tri-service VTOL transport prototype will be issued soon to permit proposals for any type aircraft in this category. Joint service program will produce 5-6 prototypes for operational testing. Transport will lift 4 tons, fly at 250-300 mph over a 1,500,000 sq. mi. range.

► Ishikawajima Harima Industries, Ltd., has a license agreement to produce the General Electric T558 helicopter engine and its CT558-210 commercial version, but the Japanese and U.S. governments still have to approve the deal. Japanese company also is licensed to produce GE J79 turbojet engines.

► Soviet Academy of Sciences has established the Selenites Atmospheric Observatory in eastern Antarctica, near the Cosmo Sea.

# HAYNES

ALLOYS



## RESEARCH REPORTS

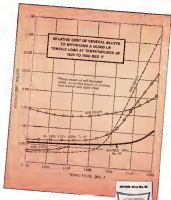
### New High-Temperature Alloy Improves Cost-To-Strength Ratio

Excellent strength and oxidation resistance in the 1900 to 2000 deg. F. range are among the features of Haynes Alloy No. 56—a new high-temperature alloy developed by Haynes Stellite Company.

A sampling of its cost advantages at a given tensile load, compared with other high-temperature alloys in the graph at right, is well worth your study.

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ALLOYS

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## Washington Roundup

### Congress Plans Probes

Watch for an unusually comprehensive investigation of the nation's space program next January by the House Science and Astronautics Committee. That committee has embarked last year for its annual hearing and subcommittee hearings.

But the new hearings have been skillfully planned to look deeply into a broad variety of subjects. The committee is expected to reach down as far as the dawn of aerospace level in citing rocketry activities for expert testimony.

Industry and the military services also may be in for a round of investigations on old, familiar areas. Procurement costs, which Congress has become increasingly tougher about, head the list. In 1958, Congress introduced the services for lower engineering programs. Last year, it voted a one-half per cent cut across the board in procurement costs, and this year it cut all fiscal 1961 procurements by 2%. It has warned that it will not cut more unless it is satisfied the corrective measures taken in the meantime.

Air Force has gone beyond its regular requests to industry to tighten up and has begun surveys of specific companies to see whether present management techniques can keep pace with modern weapon technology. First on the list is Martin Co.'s Titan program. USAF's Inspector General will lead the survey team.

Reorganization, conflict of interest, tax department, rationalization of missile launching contracts, routine and irregular contracts, and subcontracting to small business are all in the arena of saving dollars of activity.

### Electra Investigation

Hearings on the Electra crash at Boston will be held this week by the Transportation and Astronautics Subcommittee of House Interstate and Foreign Commerce Committee, followed by a look at the aircraft's development.

Next month, the same committee will look into the Federal Aviation Agency. Rep. John Bell Williams, the chairman, will investigate the way the FAA act is being administered, whether FAA is following the law or intent of Congress, and how the agency makes and enforces its rules. He also intends to get over airline maintenance procedures. Tentative date for the hearings is Dec. 14, 15 and 16.

The spectra of former Defense Secretary Charles E. Wilson still haunt the Army, even though the Eisenhower Administration is about to leave office. Four years ago last week, Wilson issued a memorandum limiting the size, weight and range of Army missiles and aircraft.

The famous memo started the Jupiter-Thor intermediate range missile war within the Pentagon walls, and it still serves as a psychological barrier to the Army and its development activities. Exceptions to the memo have been made in specific cases, but Richard Moore, Army's research and development chief, considers it very extensive a "ciding" influence. He has moved Defense's office of Research and Engineering to assist it.

Keith Gleason definitely will not remain at National Aeronautics and Space Administration administration under the Kennedy Administration. He is taking leave that he will be taking a well earned vacation in Europe about February, before returning to Cleveland. He has been on leave from the presidency of Case Institute of Technology.

### USAF Budget Plans

USAF does not plan to develop a tactical range missile as a long range intercepter unless the budget it submitted is approved. That was told for a final 1962 spending level 10% above the current budget. Air Force also has no money earmarked for the Convair B-58 bomber as its new budget.

Examine publicists don't agree with Air Transport Assn. President Stuart Tipton's opinion that Aeroflot made a mistake in committing to him its air transport contracts instead of negotiating with the public service in general.

A new Soviet brochure entitled "Aviation in the National Economy" says that the B-18 and An-30 helicopters have better takeoff and landing characteristics, are two to two-and-a-half times less fuel, don't require construction of long concrete runways, are simpler to operate and have considerably lower tonnage costs than turboprops. Later in the 1959-1961 seven year plan, Aeroflot plans to increase the use of straight jets.

—Washington Staff.

# USAF Launches Anti-Satellite Program

**Saint to begin with three-year demonstration phase; \$60 million project calls for four test interceptions.**

Washington—Dedicated program to pit satellites with interceptors, intercept and kill capabilities against unidentified, potentially hostile satellites is being initiated by the Air Force under Project Saint, drawing three years of planning and preliminary studies.

A three-year demonstration phase—costing some \$60 million and calling for the launching of four target satellites and four interceptor satellites—will begin immediately after the final selection of contractors for the year 1970 Saint program has been completed under Phase I studies. Some 500 satellites, known to be in orbit, will have an anti-satellite capability by 1983.

If the feasibility of Saint-for satellite intercept—as proved by the demonstration phase, a highly accelerated development program for an operational system is expected to follow.

Twenty-two years after the first intercept attempt in September on the Cuban spy satellite and pushed into the National Defense Science and Engineering Administration of the Air Force, the program has been approved by the Joint Chiefs of Staff, the Air Force and Defense Department officials expected by mid-December.

## Saint Launching Vehicle

Launching vehicle for the demonstration satellites will be the Centaur Atlas (topped by the Lockheed Bell Agena B) stage. Saint will be essentially three-stage conversion of the first stage propulsion vehicle (an integral part of the launching vehicle) and separating the target satellite.

Later operational versions would use satellites with capabilities, because it is estimated that enemy satellites may come in every version that could be used at target on earth or in other means of space military action.

Launching vehicle for the four target satellites will be the same as for the Saint or it might be the lighter Thor-Able Star, which has been used to put Transit and Comstar satellites into orbit.

A light vehicle had four orders placed for the launchings of the demonstration satellites beginning about the end of 1962 and covering a period of five to six years.

Both target and demonstration probably will be launched mid-1968 from Cape Canaveral, Fla., into 480-mile orbits above following the same general trajectory as the first stage of the Thor-Able Star mission satellite (AO No. 7, p. 57).

Demonstration satellites probably will be designed to function for 7 to 14 hr in orbit because of the electrolytic nature of the data required for power feasibility. This would require only a limited power supply, channeling the need for solar cell panels or long-

life energy storage capability and making needed connection between adequate for the job.

## Power Requirements

Probably no more than 10 to 1 kw of power would be required for the satellite during the brief phase for all power elements, which end during the orbital period should be no more than about 10 watts.

The Agena B stage would place Saint

into an orbital path near enough to that of the target satellite for sufficient maneuvers to begin. Saint then would enter the final propulsion stage as necessary for launchings for interception.

Maneuverability of the final stage will be one of the most difficult and important aspects of the project. The stage will require maneuverable rocket motors for longitudinal and transverse thrust and attitude control jets. Only a relatively small amount of maneuvering thrust should be required.

A direct intercept technique probably will be used. With this technique, the target satellite would be allowed to make one pass while ground stations passed orbital data for computing what trajectory is required to launch Saint into an intercept orbit on the target's orbital path.

Saint probably will be launched slightly above and ahead of the target satellite, rather than into an orbit less than 100 miles in advance of the target. The speed then the target, Saint would cross, approach and then close its proximity with overworks to close its orbit and bring it into reasonable proximity with the target.

## Parking Orbit

Technique of attaining the Saint demonstration in a parking orbit and then launching at a target satellite with the target is not likely to be adopted because of the regular power supply requirements involved during the extended parking period.

Use of the direct intercept technique involves use of a technique of using one satellite to intercept and impact the target and a separate satellite to carry the kill mechanism. The parking orbit might be used for the interim satellite.

Saint demonstration probably will serve only a technical exercise and a test run for intercept, since the expense involved in launching it would be that the basic concept is feasible. This might be the first use of such a satellite.

Initial intercept distance requirement may not exceed 30 to 40 mi. Calculation of how precise the position must be for the initial separation distance between Saint and the target. Inspection, however, might require the Saint to approach the target at speeds as 50 to 100 ft.

Operational Saint probably would include radio, TV, infrared, optical, electronic measurements and other sensors to determine if the target contained a nuclear weapon.

Inspection requirement for intercept satellites also would include the ability to distinguish between armed

satellites and false, false-like decoys. One method of determining mass of the target in order to estimate its response weight might be to acquire the impacting satellite to move close to the target and then fire retro-rockets against it, judging mass from the target's relative rate of acceleration.

Use of ultrasonic infrared satellites already in orbit at targets is not expected in the Saint demonstration, unless the orbital characteristics of the target satellite happen to combine to requirements of the experiment.

Use of a "peep-hole" target satellite, launched at targets and operated in orbit, also is considered as likely because the orbits would be so close initially that the experiment would be feasible.

Several concept originally was incorporated in a General Operational Research Study. It evolved into a Systems Development Study in 1957. Several studies were issued under Study Requirement 137 in 1955 and were revised on last year by Space Technology Laboratories and Radio Corp. of America.

Development plans were set first until the middle of 1959. Review and updating occurred only that year and again in mid-1961. This last evaluation of the development plan was done by an ad hoc, also is considered as likely because the orbits would be so

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close initially that the experiment would be feasible.

## Army Mounts Major Budget Fight For Acceleration of Zeus Project

Washington—Army has mounted a major effort to push its Fiscal 1962 budget request for nearly half a billion dollars to accelerate the Nike Zeus anti-ICBM program, having its campaign on development progress and new look at the program.

The campaign has been approved by the Joint Chiefs of Staff and the Defense Department, but the Army is fighting a major battle to get the budget request for nearly half a billion dollars to accelerate the Nike Zeus anti-ICBM program, having its campaign on development progress and new look at the program.

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development of new powerful interceptors. The greater speed would permit more interception than from the warhead's limited target.

As Five years ago that the Zeus system has been in the air, but before intercepting a missile. It is assumed that the missile would be launched from the base to intercept multiple warheads or to delay down during the cooling and cooling phases multiple the third and more from the cost of defending against it. Air Force approach is to intercept the missile in its powered flight phase.

## Control Center Role

Under Army plan, Zeus control centers may be in scattered areas of the country, with each center controlling a number of missile batteries. Each center will be equipped with an interceptor radar to spot incoming targets and give the signal to tracking centers to plot the trajectory.

The acquisition radar uses separate transmission and reception antennas. The receiving antennas consist of three arrays placed in a horizontal, triangular pattern which can rotate horizontally in a full circle. The receiving antennas are connected to a tracking system, which is a three-dimensional, very accurate detector of target motion with the ability to focus a receiving antenna pointed up in receiving beams which rotate vertically with the tracking target antenna.

The acquisition radar, combined with computers and technical control and monitoring equipment, will be able to provide the information necessary to launch a number of incoming vehicles. Although some of the operation will be automatic, both radar and radar displays will require human judgment to be corrected.

A tracking acquisition battery will be equipped with high precision target track orders for each of trajectory guidance, separate discrimination radar, a missile track radar to guide the defensive missile, and a radar system which processes data and issues launch and guidance commands to the missile, and the Nike Zeus anti-missile missile battery.

## Zeus Configuration

The 10-ft. Nike Zeus missile will have three stages, all solid propellant. The first stage has four thrust fins with swept leading edges and flat tips. Second stage has four flat delta fins, and the third stage has four conical delta fins.

First stage, powered by a Thiokol engine, furnished 200,000 lb of thrust. Second and third stages have General Electric motors. The third stage is mounted through a ship's stern. Second stage has a slight thrust boost and third stage has a slight thrust boost. First stage disintegrates in









# Little Joe Test of Mercury Capsule Fails

By Edward H. Kikawa

Washington—Several serious setbacks in the present Mercury test-flight program came late last week when an electrical control failed under high aerodynamic loads, preventing separation of the capsule from its Little Joe booster and delaying critical demonstration of production capsule structural integrity.

National Aeronautics and Space Administration officials enough interested in the flight to establish cause of the failure of capsule and booster to separate as a separate event.

Immediate effect was to begin to correct the defect by change in wiring or switch settings.

The flight will be repeated as soon as possible, since this on the study of the capsule to withstand maximum dynamic

## Mercury-Redstone Delay

Washington—Delayed test of Redstone-launched Mercury capsule (MR-1) was postponed last week because of a leak in the altitude control gas system. This system kept the capsule around 180 days, so the boost foot is too small during ascent.

Redstone test is a preflight to suborbital Mercury pilot training flight with Redstone, at least one of which is to be made before around initial flight in the Mercury program.

person is considered necessary to qualify the capsule.

Test at Wallops Island, Va., was the fifth and last NASA had scheduled in the Little Joe booster series. Earlier

flight several occurred in July, when a test of the production capsule structure in a high angle reentry could not be made because of an Atlas launch vehicle failure (AW Aug. 5, p. 36).

## Qualification Test

Flight last week was designed to qualify the production capsule in an escape maneuver at low altitude—45,000 ft—where the maximum dynamic pressure occurs. Structures was to have been subjected to pressure of 1,000 psi and 30g loading.

Atmospheric high angle reentry flight also will be repeated.

Wallops firing team once put together a Little Joe booster with available motors and hardware, since the booster systems were delivered and each fire were fired. A seventh Little Joe booster is on order, but no customer has been assigned.

Deviations were made last week to repeat the test with Little Joe, but an alternative would be to conduct maximum pressure maneuver with a Redstone booster since the all-solid propellant Little Joe has short test time performance characteristics in Redstone and not all eight Redstones purchased for Mercury have been assigned specific missions.

Redstone test would be conducted at Cape Canaveral because ground equipment is available there for the boost vehicle and Wallops has an experience with large liquid engines.

Can not test now is award of qualification of orbital hardware produced by McDonnell Aircraft Corp. for NASA, emphasizing demonstration of structural strength under various loading conditions. Earlier Little Joe flights subjected NASA-produced capsules to high loads to verify capsule design and flight quality escape and parachute landing systems.

## Capsule Configuration

In the flight last week, a berthing test third was used on the capsule, but isolation material will shield the external orbital vehicle. General exterior structural arrangement of the Little Joe capsule was identical to the external vehicle except for the shield and shape of the parachute. Parachute is usual in the fact for McDonnell capsules, and was redesigned to be larger and rectangular in independent activities.

Booster-capsule separation was so far occurred 35 sec after launch. The second later, the escape sequence was to have been initiated with the capsule at an altitude of 15,000 ft.

Shut-down Little Joe, with capsule and escape tower still attached, was

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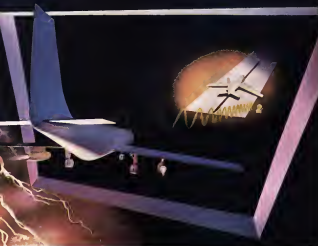
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PRODUCTION MODEL of Mercury space vehicle is mated step Little Joe booster at Wallops Island, Va., for test of the structural integrity of the capsule and its escape system.





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The system has been flight-proved in more than 4,000 landings with all types of aircraft—small private planes as well as jetliners from the DC-3 and DC-7 to the huge Boeing 707 jet. It now is being evaluated at FAA's Na-

tional Aviation Experimental Center, Atlantic City, N.J. Unlike other automatic landing systems, the Bell ALS is ground-based so a ground observer monitors every approach and landing. It can operate either fully automatically or under pilot control.

Military versions of the ALS have been ordered by the Air Force. The Navy has selected it for installation aboard the carrier-powered aircraft carrier USS Enterprise as well as for its other large carriers.

The Bell ALS is but one among many contributions which Bell Aerospace Company is making to the scientific progress and defensive strength of the free world. We invite qualified engineers and scientists to inquire about sharing our challenging and rewarding future.



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## B-70 Subcontractors Reinstated

Los Angeles—North American Aviation quit negotiations over new contracts with a number of former subcontractors last week in an effort to secure an orderly resumption of work on the B-70 supersonic bomber.

A number of contractors who were dropped from the North American team after the B-70 contract last year are now reinstated and others are expected to follow momentarily. The dollar value of the new contracts have not been settled, according to North American. Among the contractors already reinstated will be several subcontractors and:

- Sperry Gyroscope—airway gate platforms.
- Hamilton Standard Division of United Aircraft—airborne control and environmental control system.
- Federal Systems Division, International Business Machines Corp.—beam steering film and matrix guidance subsystems.
- Wallace Midway Electronics Center, Materials—minors and traffic control subsystems.
- Westinghouse Air Arm Division—defense subsystem.

IBM's Federal Systems had been working on the beam-steering subsystem under a cost-plus government contract after last year's B-70 contract. This direct contract will effectively be replaced by the North American subcontract.

Other major B-70 systems for which new contracts are being negotiated with potential subcontractors by North American are for secondary power system, flight instrumentation system, landing gear, engine air ducting, air pit and fuel storage management system.

### Seawater for flight

• Big Jet, launched Sept. 9, 1959, successfully demonstrated drops, ejections, extractions and ablation-type heat shield with an Altex booster.

• Little Joe I, launched Oct. 4, 1959, qualified eight-second booster with full-scale capsule model.

• Little Joe II, launched Nov. 4, 1959, in partial success with a high dynamic pressure abort maneuver, using a ballistic model.

• Little Joe III, fired Dec. 4, in successful test of escape system at high altitude, with a ballistic model, containing a crew.

• Little Joe IV, launched Jan. 21, in high pressure abort, with a man-in-a-board.

• Mercury Atlas I, launched Feb. 26, in an unsuccessful high-speed abort test of a protection capsule.

• Little Joe V, launched Nov. 8, in an unsuccessful high dynamic pressure abort with a graduation capsule.

One additional McDonnell capsule was tested in an off-the-pod abort maneuver May 9. No booster was used in the successful test.

## Navy Reports Gain In ASW Capability

Expensive rates of technological advance have given the U.S. Navy much more anti-submarine capability today than just a few months ago. Rear Admiral Lloyd M. Moore told a New York meeting of the National Security Council last week.

Moore, who is ASW Readiness Executive, Officer of the Chief of Naval

Operations, claimed emphatically that U.S. capabilities in the field of underwater warfare were "years ahead" of any other Communist bloc capabilities. Only if the Communists were to erect their entire fleet of approximately 150 submarines of all types in one place would they pose any real threat to the U.S. Moore added, and underlined that this could not be done overnight.

Until U.S. Coast ASW was in shallow units operating wherever there are naval operations, Moore he said, and gave overall strength figures of 5,500 aircraft, more than 200 submarines, plus the destroyer category and 100 submarines with anti-submarine capabilities.

Underlining the superiority of its capabilities, Moore said that the ASW, one system and one system, are added up to much more than twice the capability. In current services, continued operations showed that the system of 10 times the capability of single efforts, and the second and third figure could be as high as 20 to 50 in specific cases.

Future technical growth in the field is expected to be in the electronic gear needed for the complex job of underwater detection, and the further development of "clear" machines. Current aircraft, submarines and weapons either in service or about to be produced, with the need for carrying vehicles.

Moore outlined intelligence and Russian groups in the two biggest factors in the Navy's increasing awareness of Russian strength and capabilities.

## Beryllium on Mercury

Washington—Beryllium having an effect on the output of Mercury metal within a set covered with beryllium is predicted to form the highly looked forward reaction expected in the area during 1960.

Original design called for the capsule, attached to be fabricated of metal alloy, changed and corrected the alloy and expansion during heating. When beryllium and small design change, the metal alloy are covered with beryllium, then changes.

National Aeronautics and Space Administration said the change is based on the main design point modified from data obtained from the Sept. 5, 1959 Big Jet flight, which subjected peak temperature of 2,200° on the capsule heating, compared with 1,000° on the main structure and 1,000° on the design section. These alloy-body sections contained 12 fire capsules to increase heating history.





# Jet Engineer Fatigue Problem Reported

By Robert H. Cook

Washington—Crew fatigue is a mounting problem at the airlines due to jet operations according to preliminary results of a Federal Aviation Agency study of flight engineers.

During their findings on extensive physical examinations of 20 flight engineers, two physicians reviewing major FAA contract have submitted a report indicating that mental and physical fatigue are a definite problem. "They said it may be directly related to increased crew responsibilities, irregular flight schedules and increased flight duty time."

Study was made over a three month period on 23 engineers assigned to domestic and international transport flights. The doctors have recommended that FAA expand the type of study to include more engine workload and a greater variety of conditions.

## Retiree Analyzed

FAA is still analyzing answers from a questionnaire sent to a separate group of 150 engineers assigned to 50 pairs of routes, 150 pairings assigned to 50 pairs of routes. The pairings consisted of one retired and one active pilot. The pairings were made to compare retired and active pilots in operations with the Flight Engineers International Association.

Pilots and other crew members were

not included in the survey because the initial fatigue complaints were filed by the FRBA, FAA said, but any results obtained could reasonably be expected to apply to all jet crew members.

Tests given the selected 20 engine crews included a three hour physical at the beginning of the examination, along with examinations started 90 min after the engineers completed their post flight laboratory examinations. Sample of the tests included a physical workload, laboratory tests, X-ray studies, electrocardiogram, complete blood counts, amniotic and blood sugar tests, along with neurological psychological studies to evaluate current tension and ability to think under stress.

Two of the group flying international routes were examined by Dr. L. J. Shumway of the New York University Medical Center in New York, and the balance assigned to domestic routes were studied by Dr. Bruce V. Lerman in Los Angeles. Civil Aeronautics Board studies completed from the engineers, who noted a general difference in fatigue between pre-engine and jet aircraft assignments. They complained that fatigue on jets became most noticeable after about two months.

Dr. Shumway reported that his group found they have been forced to spend more time on duty to log their engines' 35 hr monthly flight time, with

the result that the engineers have found themselves spending less time at home and getting insufficient rest from previous flights. In addition, they complained that the jet's high speed and turbulent flexibility has disrupted their sleeping habits because of constant flights through changing atmospheric time zones, and has also subjected them to health hazards as a result of time which often causes fatigue and time pressure forces within a matter of hours.

While electrocardiogram, X-ray and amniotic tests on these crew failed to disclose any physical damage, the doctor said, further tests on these flights, mood and fatigue levels within the bloodstream indicated a "definite trend of stress unusual for men of their age."

## Higher Cholesterol Levels

Noting a "marked and obvious difference" in the cholesterol level of the 10 flight engineers, compared with 10 average men of different occupations, Shumway noted a general difference in fatigue between pre-engine and jet aircraft assignments. They complained that fatigue on jets became most noticeable after about two months.

Dr. Shumway also found that fatty deposits within the engineers' bloodstream were considerably above normal, with a test reading of 155 milligrams compared with the usual level of 110-140 milligrams.

Analysis of the test information seemed to indicate a trend between fatigue and three blood studies, the doctor said, but more research in this theory would require a second physical study of flight engineers exposed to less frequent schedules for comparison purposes.

While Dr. Lerman said that he would not determine the medical cause for fatigue among the domestic transport flight engineers in his group, he noted that their fatigue was "generally due to increased reaction resulting from irregular flight schedules and a lack of proper rest between flights."

As with the New York group, these engineers also complained of inability to return their vigor after 3-5 months of jet duty and pointed out that they seemed more tired after 4 hr of transport jet flying than they previously had on pre-engine aircraft flights of more or more than 10 hours.

While none found fault with their monthly flight hour limitations of 30-35 hr, Dr. Lerman said, they were uncertain in combination of schedules which they considered have forced them to spend as high as 275 hr on duty

a month to log their flight time. From stretch duty, in comparison, greatly curtailed 1-4 days not between flights, while pre-jet jet assignments were less onerous. The same was true for jet, the engineers complained.

Dr. Lerman noted that the jet time required for the engineers to meet their flight time on jet transport is approximately 100 hr a month, much less than would be an indication used to reflect their status.

FAA officials say they would like to see this data, they reported, as no more than 150 hr is a month in order to bring their members' work schedules for jet use in balance with the flight hours they are given of jet transport schedules. As an example, they point

out that as a pre-engineer schedule from New York to Frankfurt, flight engineers can accumulate 36 hr of flight time in 72 hr, every three days. The same pre-engine schedule with turboprops would give the engineers less than 37 hr flight time for the same 72 hr period.

Flight engineers examined by Dr. Lerman ranged from the age of 38 to 45 with average flight experience of 1940 hours 1.5 years of jet transport. Before the physical examination, an FAA representative advised FAA, more tests should be undertaken with a younger age group which has been forced from pre-engine to turboprop aircraft and with a second group having only jet experience.

## Freedom To Compete With Trunks Asked for Supplemental Airlines

Washington—Carter competitive freedom between the supplemental airlines and trunk carriers was urged by the Independent Airlines Association to counter the threat of a consolidated air transport industry.

C. L. Russell, IAA president, told a recent meeting of the American Space Writers Association that current Civil Aeronautics Board bidding rules for National Air Transport Service contracts plan a "one-sided competition" against smaller supplemental airlines. He raised a basic question of "whether or not the trunk carriers, and particularly the five or six who dominate the entire jet traffic market, will be permitted by the Board to prevent the air transport industry."

Warning that continued domination of the industry by a few airlines could lead to the "nationalization" of the industry, he said, "it seems apparent that if not competition and opportunity for new entrants and new routes it is to be replaced by a few big air carriers backed by the CAB, the air transport industry is being pushed and dropped toward consolidation."

Russell emphasized the supplemental airlines' efforts to offer low cost air fares, and characterized the competition between trunk carriers as "contingent" on various administrative agencies, rate agencies and public opinion treatment "under a system of administered free prices."

"What the entire air transport industry must do is to make the United States the most competitive in the world for flying 320s, for the Civil Aeronautics Board, and possibly for a flying 720 order."

Criticizing the supplemental with pro-

cesses. Since the competition of the supplemental is removed, these carriers will no longer bid the rate floor and prices to MATS will skyrocket further.

"The large jet carriers and only want to compete or negotiate for groups" he added, "but want to place the industry under an individual system of their own. The rate floor is \$1.00 per mile for high commercial rates subject to relatively small inflation discounts. If this rate is reached with the aid of the CAB, the industry becomes a prisoner of the large jet carriers."

Russell estimated the maximum cost increase resulting from the new 2.0 cents fare would approximate \$36 and cents usually for planned transportation as compared with the cost of \$12.5 million for individually ticketed passengers, which supplements are now authorized to handle.

## Airline Effects

Effects of some flag airlines to greatly improve with the industry for a contract to serve military passengers at irregular civilian rates were encouraged by CAB officials. They said that against any possible in-flight services, and according to giving the system a "bullet proof" and increasing their level of service to the Department of Defense, Russell charged.

One legal change of the program, he said, was a provision calling for a two-year order for revivability to either the passengers or the airlines. Such a provision would have the legal effect of obligating the government for a two-year period even though a new Administration might desire to terminate the contract. He said.

Outlining the growth needs of the supplemental airlines, Russell took particular note with CAB regulations limiting the services through flights to airports which are located in geographical scope and lower membership that have existed for a period longer than six months.

The restrictions, originally intended to protect the trunk lines from the loss of intercontinental passengers, is now obsolete because of the jet era, with its "colossal trunk carriers" and the system's "expansion in air traffic."

The government is facing the transfer to itself in the government's own hands to rather than as he does, Russell said. In other words, Russell said the supplemental airlines need protection against the amount of surplus flight equipment assigned by trunk carriers in charter business. He suggested CAB regulations which would limit the large carriers to a maximum of 10% of the fleet. He also cited a need to expand the supplemental airlines' operating authorities beyond their present limitations of 100 round trip flights a week for individually ticketed passengers.



## WHAT'S IN YOUR AIR CARGO FUTURE...

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Route pattern complexities of typical airlines demand a cargo aircraft with the capability of operating over both short and long route segments with excellent economy and earning ability. The Canadian Forty Four will do this for you! It combines the air-cargo feeder liner with the long-range aircraft to provide a standardized economic fleet unit. The Forty Four will give you profit-making operations, at current rates, over major segments as short as 200 miles and as long as 4,000 miles.

This is the type of flexibility that will answer the many and varied problems confronting airline operators who, because of the growing demands of shippers, are being forced to provide a combination of short, medium and long range air cargo services for the carriage of freight at attractive and competitive tariffs. In this situation, the Canadian Forty Four offers excellent economy and earning ability over the complete range of route segments that must be provided in the collection and distribution of air cargo.

Proven applications of this are found in the short route cargo services that are necessary in the supply and distribution of goods to or from the terminal points of trans-continental and long-haul services. This is evident between the major cities of the Eastern United States and between the principal points of Europe. These inter-city routes are essential to economic long-haul truck service, and with the Forty Four can be handled without a change of aircraft.

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The need for this system of short, medium and long range operations will develop through the growing awareness among businessmen that the transportation of articles by air is becoming an essential element in the overall marketing function. This will open up new markets, new transportation requirements, new inter-city services. The Forty Four, with its flexibility of performance, can easily support a profit over the whole distance spectrum—short, medium and long range, and has the verified performance characteristics to get in and out of 80% of the world's major airports. THERE ARE SIGNIFICANT ADVANTAGES IN FAVOR OF THE FORTY FOUR.

#### SOME RUNWAY AND PAYLOAD SPECIFICS ON THE FORTY FOUR

1. Price increases as short as 6,000 feet, can operate with 70% payload up to stage distance of 3,000 miles.
2. Can operate from 85% of the world's major airports, with due consideration to both runway length and aircraft wheel loading.
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5. Break-even load factor on larger personnel equipment represent major profit payloads on the Forty Four.
6. Can operate non-stop on the London-New York route with an average annual payload of over 55,000 lbs.

in the mailing room. These are, but I wish the sort of government open you for your indifference."

"I am subject to the depths of my soul at the indifferent attitude toward passengers."

The writer points out that many passengers are not by themselves leaving the plane to visit a shop at Vancouver when it actually leaves from Montreal or Sydney, a third Moscow airport which was to have been closed down 18 years ago but has seen a traffic increase in that period of 10 times the volume handled in 1950.

They emphasize that there are no accommodations for only 151 people at the hotels of these airports and that passengers spend in such time waiting for baggage to be placed on the trip from Kiev to Moscow.

They concluded that the "technology of the sky is not lagging" but adding:

"A variety of special problems, solution of which, in a mile, depends on Aeroflot stock, are holding back. No doubt, the handling forward movement of the air technology. These problems must be solved and as soon as possible. Facilities service on the ground must be in keeping with the technical perfection in the sky."

### Los Angeles Studies Future Airport Needs

Los Angeles-Comprehensive study of the future airport and aviation requirements for Los Angeles and the surrounding area has been started with Stanford Research Institute appointed to conduct a study of the requirements needed to determine the long-range facilities required.

Cost of the study may reach \$500,000 and will be jointly supported by the House Research and the Southern California Incorporated Foundation. The study will cover a five-county area including, besides Los Angeles County, Orange, Riverside, San Bernardino and Ventura counties.

Purpose of privately financing the study is the two airports' development is to eliminate the possibility of special interest groups or special financial groups getting any special consideration in respect to airport planning. Scope of the survey will cover military, commercial, private and business aviation and information will be sought from commercial airlines, land-based operations, fleet operations and other sources. Stanford's preliminary study is scheduled to be completed in January, 1961.

Analysis of the preliminary study will make it possible to determine the stage areas of further research required and the most effective course of action which the research sponsors might follow at subsequent research.

keeping airlines on schedule...  
that's part of our job, too!



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SCANDINAVIAN AIRLINES SYSTEM  
PAKISTAN INTERNATIONAL AIRLINES  
SABENA  
SWISSAIR  
TRANS-CANADA AIRLINES  
VAMP  
UNITED AIR LINES

## Airline Traffic—September, 1960

	Revenue Passengers	Revenue Passenger Miles	Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor, %
<b>DOMESTIC TRAFFIC</b>								
American	759,038	347,371	88.4	1,740,319	3,100,029	10,270,000	47,260,448	88.6
Boeing	199,241	92,470	81.8	493,337	142,139	363,742	16,342,106	89.8
Continental	211,143	128,784	84.9	324,766	237,121	320,671	19,498,138	90.2
Eastern	116,594	79,829	89.5	216,317	134,750	600,995	9,578,831	90.2
Delta	377,149	146,402	88.2	449,793	347,147	1,493,484	18,125,470	87.4
Eastern	445,207	217,313	85.49	1,192,267	696,514	2,213,212	26,285,327	91.48
Northwest	134,402	68,424	84.7	324,255	72,870	558,144	7,361,714	86.5
Northwest	445,207	217,313	85.49	1,192,267	696,514	2,213,212	26,285,327	91.48
Trans World	498,288	411,244	82.4	3,443,498	864,584	4,612,899	48,947,208	93.4
United	778,540	374,200	86.4	2,837,200	1,993,916	7,472,204	46,271,176	90.1
Western	126,302	79,138	80.4	511,200	18,281	327,467	5,861,176	86.8
<b>INTERNATIONAL</b>								
American	6,314	9,267	82.9	8,404	684	177,419	1,193,793	80.4
Boeing	5,273	11,360	88.7	31,377	122,374	1,204,289	1,268,040	88.8
Continental	27,058	1,477	89.5	1,477	7,476	183,108	183,108	89.5
Delta	1,041	1,490	89.7	2,320	18,340	109,900	129,960	89.7
Eastern	99,194	28,148	89.8	82,440	4,456	136,301	1,792,339	89.8
Northwest	6,737	1,321	84.3	1,321	8,131	258,444	267,696	84.3
Trans World	1,433	1,140	80.4	1,200,302	14,324	1,279,232	4,938,634	80.4
United	17,444	31,404	87.4	1,200,302	14,324	1,279,232	4,938,634	87.4
Western	4,203	4,777	84.4	16,474	147,417	950,363	1,114,254	84.4
American	163,838	204,445	84.7	2,110,311	4,401,375	30,225,044	36,736,730	84.7
Boeing	90,521	113,440	84.4	1,011,349	4,176,194	18,441,184	23,628,727	84.4
Continental	41,127	190,404	70.4	2,120,471	3,123,471	3,960,199	9,204,141	70.4
Delta	10,108	14,722	82.7	16,340	69,543	3,960,199	4,045,862	82.7
<b>OVER-ALL</b>								
American	39,476	120,744	86.1	1,426,014	1,729,723	18,271,180	21,426,917	86.1
Boeing	17,427	40,394	87.7	375,107	1,111,074	4,647,649	6,133,820	87.7
Continental	5,209	5,933	89.7	7,746	47,784	491,100	546,450	89.7
<b>LOCAL SERVICES</b>								
American	47,340	13,643	84.7	24,007	90,227	27,194	1,424,638	84.7
Boeing	31,404	5,291	86.4	4,721	4,332	10,328	894,804	86.4
Continental	2,700	2,700	84.7	2,700	2,700	11,328	910,367	84.7
Delta	28,320	9,124	81.8	35,400	1,471	44,803	887,380	81.8
Eastern	20,710	3,168	86.9	6,120	10,493	1,049,192	1,069,782	86.9
Northwest	40,409	10,146	81.8	21,146	23,008	23,008	1,141,643	81.8
Trans World	47,340	13,643	84.7	24,007	90,227	27,194	1,424,638	84.7
United	34,336	9,420	82.7	14,149	10,506	31,563	891,261	82.7
Western	43,127	4,506	86.4	13,756	16,168	39,347	1,067,477	86.4
Boeing	30,314	3,740	87.7	13,756	11,324	13,703	863,281	87.7
Western	24,224	3,740	86.1	14,893	5,160	34,199	846,611	86.1
<b>BARBERAN</b>								
American	46,818	4,416	86.9	3,202	6,444	346,311	346,311	86.9
Boeing	46,818	5,114	84.7	12,770	184,312	994,044	1,179,126	84.7
<b>GARRETT LINES</b>								
American	1,040	1,040	79.4	40,002	14,000	440,000	440,000	79.4
Boeing	1,040	1,040	79.4	40,002	14,000	440,000	440,000	79.4
Continental	1,040	1,040	79.4	40,002	14,000	440,000	440,000	79.4
Delta	1,040	1,040	79.4	40,002	14,000	440,000	440,000	79.4
Eastern	1,040	1,040	79.4	40,002	14,000	440,000	440,000	79.4
Northwest	1,040	1,040	79.4	40,002	14,000	440,000	440,000	79.4
Trans World	1,040	1,040	79.4	40,002	14,000	440,000	440,000	79.4
United	1,040	1,040	79.4	40,002	14,000	440,000	440,000	79.4
Western	1,040	1,040	79.4	40,002	14,000	440,000	440,000	79.4
<b>REDCORP LINE</b>								
Chicago Helicopter	89,563	484	46.9	1,224			47,276	46.9
Los Angeles Helicopter	114	114	80.4	4,207			2,214	80.4
New York Helicopter	11,999	520	87.2	1,204	478	563	47,161	87.2
<b>ALASKA LINES</b>								
Alaska Airlines	15,656	10,146	81.8	75,707	4,499	430,246	5,133,177	81.8
Alaska Central	6,292	233	86.4	3,104		5,134	7,449	86.4
Alaska Coast	1,404	369	80.4	1,404		4,407	4,407	80.4
Alaska	4,199	89	86.9	3,120		5,134	43,704	86.9
Northwest Consolidated	773	20.4	81.8	1,140		4,407	4,407	81.8
Pacific Northwest	10,260	11,147	82.3	134,449	10,420	415,106	5,746,176	82.3
Seas Air Lines	417	34	79.4	62		1,433	6,174	79.4
Western Alaska	5,875	1,373	82.9	47,796		47,796	261,112	82.9
Western Air Transport	16,107	340	82.9	626		618	55,766	82.9

<sup>1</sup> Not available

<sup>2</sup> No operations this month

<sup>3</sup> Delayed part of the month as records disclosed by De

Cancelled by Aviation Week from airline reports to the Civil Aeronautics Board

Minuteman, the nation's first solid-fuel ICBM, blasts from underground silo, left, in tethered firing test. Successful Minuteman firings cut test program, saving millions of defense dollars. Boeing is weapon-system integrator of the 6000-mile-range Minuteman missile, now under development.



**FLYING COUSINS.** You can cross a continent or an ocean in brief hours by Boeing jetliner, then fly to home airport or emergency in a helicopter built by Boeing's Vertol Division. Vertol helicopters are flown by the U.S. Air Force, Army and Navy as well as by the commercial carriers and armed services in many countries. Boeing Vertol and Vertol-built proved jetliners in the world have already carried more than 16,000,000 passengers.



**HOTSHOT TUNNEL.** Here, in largest privately owned wind tunnel facilities in the world, Boeing aircraft, missile and space-vehicle models can be tested at speeds up to 10,000 miles an hour. Many space-flight conditions can be simulated during tests. Hundreds of engineers and researchers have studied Boeing to power future-breaking advances in wind areas of manned and unmanned flight.



**BRAGGING TURBINES.** Boeing gas-turbine engines power the high-speed oil company jet-powered boat, as well as U.S. Navy man-of-war, launches and landing craft. Light, powerful, compact Boeing shaft-drive turbines have scored many firsts: first turbines to power highway truck, fire engine, helicopter, locomotive and light airplane. Boeing turbines also drive in jet-engine starters used by U.S. Air Force and commercial airlines.

**BOEING**

## AIRLINE OBSERVER

► United Research study on international civil aviation policy (AW June 13, p. 38) was scheduled to be discussed to the White House late last week.

► French government has stepped into the dispute between airlines and jet air crew over working hours. Government has ruled jet flying time for crew should average 75 hr monthly. In addition, crews on long jet flights are required to have at least four consecutive days off each month. Crews were holding against airline attempts to keep them working on jet more or less at the same pace as on prime routes.

► Air Line Stewards and Stewardesses Assn. attempt to drop its affiliation with the Air Line Pilots Assn. is being blocked by the AFL-CIO, which feels the inter-union agreement should be settled internally. ALSSA has failed to get an independent charter, and AFL-CIO President George Meany has asked the pilots' union to drop a suit filed against the stewardess union after ALSSA severed from ALPA headquarters. As a result of Meany's personal intervention, ALSSA and ALPA officials met in Washington recently to discuss their differences.

► Federal Aviation Agency has intensified its bid control program at Washington National Airport. Control tower operations, operations officers and airport police are under orders to maintain strict vigilance for unusual bird or wildlife activity at all times. Advisers information on bird activity will be issued to pilots, and pilots can be dispatched to areas of heavy bird concentrations where extra birds will be used to disperse flocks. Shotguns might also will be used to scatter birds without injuring them. Consultations with Fish and Wildlife Service experts, Smithsonian Institution officials and Audubon Society members will be held to determine other means of controlling bird flights at airports.

► Trans World Airlines' experimental use of Ede Lenn and Doppler navigation aids is drawing heavy fire from the Transport Workers Union, which fears use of the equipment may lead to eventual displacement of TWA navigators. Union spokesmen complain that installation of the aids on the control panel of one TWA Boeing 707, instead of at the navigator's station, has resulted in the cockpit taking over strictly navigational duties an instrument flight.

► Federal Aviation Agency has issued an order specifying that contracts negotiated by the agency in which FAA supplies part or all of the funds must include a provision under which a fee share of the rights to data and patents will be retained by the government. Since it is to be an inalienable proportion to the respective contributions of the agency and the contractor.

► Number of transits leaving United Kingdom by air exceeded those traveling by sea for the first time during the first six months of 1960.

► Pan American World Airways and is incorporated in a larger, turbo-propelled Boeing 707 though it has failed to go ahead on a reason designated the 707-520. This airplane would have a longer fuselage and an increased thrust system of the Pratt & Whitney JT1D turbofan engine. Pace is reported in a mounting block.

► English-Impert Bank of Washington has extended a \$3.4 million credit to TWA, independent French airline, toward the purchase of one Douglas DC-8 turboprop transport. Total cost of the airplane is \$4.8 million, including equipment and engine system. TWA will pay about 40% of the cost in advance, with Douglas Aircraft Co. financing the balance of \$600,000. French American Banking Corp. of New York will participate in the French bank's credit to the extent of buying only securities in the amount of \$727,500.

► Work for a move by El Al Israel Airlines to expand its routes into Africa. Israeli government delegates to now conducting talks on possibilities of negotiating bilateral air transport agreements with Ghana, Liberia, Nigeria, Mali and Senegal.

## SHORTLINES

► British European Airways is planning to start service to Budapest Apr. 1, 1961, following agreements reached by the British and Hungarian governments. BEA will serve the Hungarian capital twice weekly by extending its London-Frankfurt flight Monday and Thursday. Vickers Viscount 880s will be used.

► British Overseas Airways Corp. is using de Havilland Comet to extend from Manchester service to its London service to the Far East and Australia. The British carrier has increased its London Singapore service from two to three flights weekly and London-Australia service from 10 to 12 flights weekly. BOAC has begun weekly London-Korchi service with the Comet 4 and is operating a twice weekly service from London to the Persian Gulf with Comet 4s for its associated airline, Middle East Airlines.

► Civil Aeronautics Board has granted permission to Eagle Airways (Bremont, La.) and Eagle Airways (Bismarck, La.) to operate jointly under the name Grand Eagle Airways. Grand Street Ship Co. recently acquired control of Eagle and wants the carrier to operate with the Comet four.

► Federal Aviation Agency will name L. W. Burton as director of Washington National Airport. Burton, on leave of absence for the past few weeks, had been acting director of the Bureau of National Capital Airports as well as director of Washington National until the appointment of G. Ward Hobbs as director of the bureau.

► Northwest Airlines has begun daily transatlantic flights with Douglas DC-7C aircraft to fill the gap in service caused by a strike of flight engineers, belonging to the International Assn. of Mechanics, which has prevented Northwest's fleet of Douglas DC-3 transport transports. The airline formerly operated four DC-3s and eight jetliners and three DC-7Cs round trip weekly between the U.S. and Far East.

► Trans World Airlines has started three new all-jet flights this month using converted Lockheed L-649 aircraft. TWA began two new weekly New York-Stamford-London-Panama flights Nov. 8, making a total of five flights weekly. A new daily New York-Los Angeles-San Francisco route was scheduled for Nov. 16. In addition, TWA was scheduled to begin daily service from Philadelphia to New York, Chicago and Los Angeles Nov. 16.



Could you pick the guilty part?

Professional airline bastards say there's no such thing as "looking like a criminal." And it's much the same with replacement parts. A bargain price substitute often resembles the original so closely that even a master sleuth would be hard put to find a single clue to prove the difference. But it doesn't take your engine long to detect any hidden weak spots. And right there, instead of saving money, you may face charges for costly major repairs.

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CONVAIR B-58A proposed supersonic transport configuration would be all aluminum alloy aircraft to operate at Mach 2.4 cruise range. Capacity would be 52 passengers and range would be on the order of 2,600 miles at 5,000 feet.

## B-58A Proposed for Transport Research

National research program based on the B-58A bomber and aimed at establishing design requirements for supersonic and subsonic supersonic transports is being proposed by Convair Division of General Dynamics Corp.

Major advantage of the program is a national level in the field of the new, say, between now and 1965 when the North American B-70 begins to accumulate Mach 3 flight hours. Convair's program would parallel the B-70 project and would be expected to produce data supplementing that coming from the B-70 flights.

Advantage to Convair is that the company can exploit and capitalize its current B-58 B-55 flight experi-

ence at Mach 2 to strengthen its competitive position in the race to a Mach 3 transport, the special goal of the majority of American officials now in the nation.

### Three-Step Program

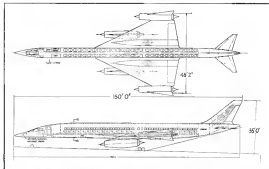
Convair's program aims at the easiest, fastest and cheapest way to get operational experience with an airplane simulating a supersonic transport. It starts with the B-58A Hustler, currently the only available plane capable of sustained supersonic flight. It Mach 2.4 has been above 1.5, and builds that through step program.

• Building B-58A would be completed in about 180 days of experience

specific working in the range from Mach 1.5 to 2.8. This phase of the program would provide an engineering and operational foundation for solution of numbers of problems including such correct solutions as aspect operations on the ground and in the primary airway traffic control, noise issues and handling characteristics consistent with passenger-carrying operations. Part of the step is already completed by National Aeronautics and Space Administration for the next step. Using a B-55 operating out of Edwards AFB, NASA plans and technicians will investigate the handling characteristics of the plane in sustained supersonic flow. They will study all flight phases from takeoff through landing, with side experiments into ca. noise problems of ATC, navigation, recovery and alternate.

• "People-proof" with room for five passengers and test instrumentation would be carried by the B-58A in the second phase of the program. Purpose would be to evaluate the subjective attitudes of passengers in the natural environment of a supersonic transport cabin. One example: Pulling back power abruptly at Mach 2.4 cause problems a 0.7g deceleration has about the level predicted by the most severe current certification of braking and thrust recovery. Convair may wish a modified B-58A could fly only in 1963, and would recover by about 57 miles a program cost.

• B-58 transport, model configuration B-58, would be designed and built in a test quantity of a dozen. Two design,



MODEL B-58C two view shows basic aerodynamic geometry of Convair B-58C strategic bomber project modified to make the lowest subsonic for a supersonic transport. Horizontal tail has been added and fuselage elongated and extended for other space.

drawing on the work already done by the company in preparing a B-58C representative three-tonne in Strategic Air Command, would be covered in four Part 25 Whitehead 150 (subject) rated at 12,000 lb thrust each without afterburning. The B-59 would run 12 passengers as a conventional bomber replacing the bomber fuselage of the B-58C. Operational speed range would be Mach 3.4. The airplane would be all-aluminum structure in exposed to the standard-outlook of the B-70. Convair program dates call for a first flight late in 1965 and a total cost of about \$300 million for design, development, construction and testing of the 12 airplanes.

This last step according to Convair engineers, would provide the first bits of data needed to determine the mid requirements for a supersonic transport. With a direct path toward flying in and out of congested fields and operating on the world's busiest airway systems, the key issues of passenger comfort, economy, maneuverability and operational experience could be passed down early and in a short overall time cycle that would meet the requirements of a 1970 era tactical jet.

Maneuvering thrust of the B-58 transport proposal is data from the B-58C model (that plane's) delta wing, ground peripheral arrangement, and critical tail. But a long passenger-carrying

legs replace the short bomber fuselage, and a horizontal tail is added to make the stability and control problems more easily solvable.

The B-58C started life as a proposed all-aluminum supersonic bomber built around the Pratt & Whitney J58 engine (AWA No. 18, p. 66). It incorporated a few changes in detail from including a deeply slanted postwing pylons configuration.

Convair engineers started with the

design and modified it to meet their studies requirements for a supersonic transport. These requirements were developed in complete independence which and have aerodynamic data to develop performance for a family of aircraft meeting wide range of speed and route performance. These "paper" airplanes were continuously cycled through the computer to produce a series of optimum results for any given set of requirements. Nubank believes that the B-59 is the optimum supersonic transport, but would do believe that it is the best supersonic transport that could be made available in a short time span.

### Cabin features

Cabin volume of the B-58A features is a series of single seats at the top used in the Convair B-58 and B-55 transport. Seats are set in 3-in. seats, and the aisle width is 15 in. between seats. Total capacity of the cabin is 52 passengers.

Basic performance characteristics show a Mach 2.4 cruise speed (3,375 kt.) and a 2,435-mi. range.

Block speed for the route is 1,018 kt. Time for the trip figure to be 2.41 hr. Return stage at the terminal is 915 miles.

At a takeoff weight of 190,000 lb, the B-58 would require a field length of 6,000 ft., and would lift off the runway at 190 ft. Landing would take a full-sized field length of 5,700 ft. at a



PICTURE 700 for existing B-58A Hustler bomber would enable researchers to obtain basic test data on passenger design supersonic flight.



MISSION PROFILE for B-58A supersonic transport proposal shows stepped climb to initial cruise altitude just under 60,000 ft. and progressive increase in altitude due to fuel burnoff. Cruise speed would be Mach 2.4 at 95% military power. Recovery can be studied in profile.



# INERTIAL GUIDANCE SYSTEMS NOW IN MASS PRODUCTION AT BENDIX E-P

Unified facilities turn out stable platforms in volume for Pershing, cut lead time 20%—also offer advanced inertial guidance experience in design and engineering

## Knowmanship in Action

Inertial guidance capabilities at E-P extend across three fronts—design, engineering, and production. Our production efficiency is proved by the fact that we are now mass-producing complete inertial guidance systems, including highly precise air-bearing gyros—"heart" of inertial guidance—for Pershing. We are able to do this, and save 20% in annual lead time, because of advanced techniques, and most modern facilities, coupled with most efficient management.

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E-P KNOWMANSHIP also offers practical advantages in inertial guidance design and engineering. We have

a technical staff of over 500 devoted exclusively to solving inertial guidance problems. Our engineering experience includes work with air-bearing gyros that float both gimbals and spinning mass, as well as with liquid-fueled gyros and accelerometers. Guiding specialists have developed the way to mass compact inertial guidance platform packaging.

The point is this. With demonstrated production knowmanship—plus practical design and engineering experience—we offer a new degree of proficiency to apply to your inertial guidance needs—whether they be for outer space or under the sea. Why not explore our capabilities? A word from you will bring our complete story to your desk.

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**DEFINING TEST AND CALIBRATION:** E-P checkout facilities include Eagle and Phoenix inertial test stands accurate to 200" per hour, reducing heads with an accuracy of  $\pm 2$  seconds of arc, and for controlling pendulum integrating gyros.



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This latest engineering development by the Components Department of EMD is solving critical plumbing problems in more sophisticated second generation cranes.

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Denville, New Jersey

Course cost estimates show the 55-9 could be flown with a direct operating cost (DOC) of 2.5 cents per seat mi. That translates out to \$2,000 per one-way flight hour.

### Program Timing

The Gemini program for the 38-0 configuration assumes that the order to go ahead will be given for January, 1961. First flight would be 33 months later in October, 1965. First two airplanes would be put through a company flight test program lasting 35 months, while NASA and DOD would evaluate their airplanes for a 35-month period.

Simulated commercial operations would begin in early 1964 with a MATS squadron doing the operational shakedown, and by October that year, the 12 airplanes in the program would have accumulated 2,500 total hours of supersonic operational time.

total rate of spending will rise to \$215 million the first year, increasing to \$18 million the second and \$17.5 million the third, during the years of intensive engineering design and development, and production buildup. Fourth-year spending would decrease to \$45.5 million as production and test continued in parallel, and by the fifth year the program cost would be down to that required to support the airplanes in their operational role. That figure is currently estimated at \$3.75 million.

### Program Benefits

Conroy argues that oversight in the program would be headed from the overall program, just as in earlier national programs. The company cites the joint NACA Dept. of Defense projects that produced the X series of research aircraft to boost industry across the board, and the helicopter studies/simulations conducted by Military Air Transport Service's 1,700th Test Squadron (Tusling), which led a fleet of 10,000 to all flight tests with military support personnel and the general support of operational experience by

Plastic benefits to industry, the airlines and military, and civilian agencies would be produced by the program, the company says. For instance, the airplane could serve as a post-crash test bed for a variety of engines, producing supersonic cruise data for engines without afterburning. It could provide strength and vibration data under conditions of heat-soaked structure, and answer a myriad of questions in the design of auxiliary systems operating under extreme temperature conditions.

For the sailors, Conway's program would provide the answers to most of the operational questions before the crews had to commit themselves to



### Bell HU-1A Helicopter Instrumentation

**Did you** know that the Bell HU-1A Huey helicopter, selected by U. S. Army as its new medium-sized transport (AVF Oct. 27, p. 16), is outlined in this photo and drawing. Instantaneous inflation valves on right side and two radio controls on the left hand. Army has purchased 14 of the transport for delivery to the Army Aviation School, Ft. Rucker, Ala.



Instrumentation includes: (1) altimeter (2) infrared altimeter (3) suspended altimeter (4) dual barometers (5) rate of climb (6) time magnetic altimeter (7) time and bank indicator (8) clock (9) course indicator (10) speed indicator (11) per cent barometer (12) exhaust temperature (13) fuel gauge (14) fuel pressure (15) engine of temperature (16) oil pressure (17) transmission oil temperature (18) transmission oil pressure (19) Air velocity (20) fuel meter, mass pressure air velocity (21) fuel meter, standard pressure (22) standard consumption. Dual engine look down instrument look down windshield.

## THRUST VECTOR CONTROL BY LIQUID INJECTION



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Use of enriched propellants, with consequent high gas stream temperatures, has emphasized the reliability, performance, and weight advantages of secondary injection thrust vector control. Moog has developed liquid secondary injection control with outstanding maneuverability, stream direction control and precision on characteristics. The experience gained in the design, manufacture and test of these systems constitutes a unique competency.

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finding out the hard way through the introduction of new equipment.

For the military, there would be technical benefits to add to background knowledge for supersonic aircraft design.

For the Federal Aviation Agency, the Conquest program would help solidify thinking and theory into firm design means for supersonic flight standards.

Conquest wants such a program to be jointly sponsored by those of the agencies to derive benefits from it: FAA, NASA, and the Air Force.

Admittedly, all the costs of this program are not identical. General's 17-Week plant will run down as a 3-50 production, and the company's experience so far with the Model 880 and 680 before-on, plus its uncertainty over the Model 60, leaves it in two positions: a position to tackle a supersonic transport project on its own.

Synthesizer for other segments of the American transport aircraft industry agree that no company is in a position to tackle alone the entire job of design and development of a supersonic transport. This led the world market is too small and the necessary pricing is too narrow for high terms if the entire market were created by a single company.

### Cooperative Development

Cooperative development is one proposed method now being tried in both England and France. But observers doubt that any number of U.S. companies would cooperate on a joint commercial venture.

Lacking that, the only method seems to be an outright subsidy for development, either in the form of an order for a specific number from the military, or in the form of the kind of project presented by Conquest.

Any company would hope for both to happen, but with the military still signaling its reluctance and apparently not eager to commit too much of its power for transport aircraft, any specific order from that quarter seems far off.

Even if Conquest gets this program through, it will still find itself entering 1965 with a batch of data and flight experience on a Mach 2.4 transport which, by its own admission and general agreement among competitors, is the wrong speed for a supersonic or better. Conquest will also be facing the hard fact of several hundred hours of flight time—costs including some at Mach 1-on 3-7.8 prototypes by then.

Conquest is leaving its program on the hope that progressive development through the supersonic range, with more complete understanding of the problems all the way along, will win of greater advantage than planning directly into the Mach 5 speed stage. ♦♦



## Acceleration and high shock

Testing before trigger time, are critical to the quality control of both such components at Singer-Bridgport. Today high capability in engineering, precision machining and electro-mechanical assembly makes Singer-Bridgport a prime supplier to the military and sub-contractors.

Test facilities provide the range of equipment needed to check out components and systems to their specifications: acceleration, vibration and shock, temperature, altitude, humidity, pressure conditions. Military and industrial government also find high quality control and quality production at Singer-Bridgport.

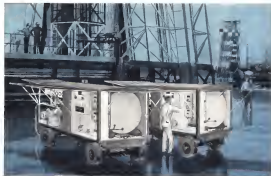
A comprehensive brochure describing these engineering and production capabilities is available to you on request.



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## HOW FMC'S CHEMICAL AND MECHANICAL EXPERIENCE SOLVES MISSILE PROPELLANT PROBLEMS

Food Machinery and Chemical Corporation, through its integrated divisional operation, offers a unique capability for the design and production of missile propellant handling equipment.

FMC's chemical background covers years of research, development and production of toxic fuels, including high-strength hydrogen peroxide and Dinitrogen (UDMH). Utilizing this extensive experience, FMC's Ordnance Division has developed many new processes, systems, and equipment for use in solving critical problems in the handling of missile propellants, among them high-accuracy metering equipment, and the Remote decontamination system.

For more detailed information on these studies and for experienced counsel on missile fueling problems, contact FMC, a leading developer and producer of chemical propellant compounds and the equipment to handle them.

For further information, write on company letterhead to Preliminary Design Engineering Dept., FMC Ordnance Division, P.O. Box 367, San Jose, Calif. Phone CV 9151.



Putting Ideas To Work  
**FOOD MACHINERY AND CHEMICAL  
CORPORATION**  
**Ordnance Division**  
1100 COLUMBIA AVENUE, NEW JERSEY, CALIF.

# fmc

Illustrated below are some of the activities of FMC concerned with missile propellants and propellant handling equipment, which help define a few of the problems successfully solved by utilizing the combination of chemical and mechanical engineering talent available.



## FMC's New Liquid Propellant Metering System Achieves Accuracy to $\pm 0.1\%$



Mobile metering and control unit for fueling liquid propellant missiles

The crucial reliability of missileage missions is influenced by the accurate measurement and delivery of liquid propellant to the missile tanks. For example, a small error in fuel weight could adversely affect the in-flight performance of the missile, causing possible failure of the entire mission.

Food Machinery and Chemical Corporation's Ordnance Division has recently developed a mobile liquid propellant metering and handling system which promises to solve many missile fueling problems. The advantages offered by this unique new system are many.

Automatically measures and records the amount of fuel delivered to the missile tanks. Original specifications called for a metering accuracy of  $\pm 0.2\%$ . Extensive tests, conducted by government test engineers, show that the system is capable of metering and delivering missile propellants with far superior accuracy—to  $\pm 0.1\%$ .

Automatically compensates for factors influencing fueling accuracy. The fuel is continuously sampled and the flow corrected for variations in temperature and density. In addition, the fuel which vaporizes in the missile tanks is returned to the system, condensed, measured, and an equivalent amount added by the metering unit.

Adaptable to many different missile fuels. The system is designed to handle such storable liquid propellants as hydrazine, nitrogen tetroxide, Dinitrogen (UDMH) and nitric acid.

Engineered for manufacturing and safe to operate. To reduce development, manufacturing and operating costs, the system makes maximum use of standard, interchangeable, and commercially available components. The simple and safe design eliminates human errors and danger to operating personnel.

Mobile and compact. All metering, pumping and control equipment is mounted on a single, portable trailer. The complete unit may be easily transported, rapidly positioned, and provides a single station for the metering of fueling operations.

The successful development of this mobile metering and handling system by the engineering staff at FMC's Ordnance Division is another achievement made possible by utilizing the unique combination of chemical and mechanical engineering talent available at Food Machinery and Chemical Corporation.





#### THE ABC'S OF CRUSADER POWER

Fighter for fighter, the Navy's *Crusader* has logged more flight time than any other 1,000-plus-eph aircraft in U. S. service. Since 1935, this Collier Trophy-winner has flown the Peace World's border-watch from Lebanon to Panama. Over 100 carrier- and land-based *Crusaders* have carried the mailings of Navy and Marine Corps squadrons. This year they are being joined by a new *Crusader*—the all-weather F9U-26A. A mono-engine, radio-guided extension of the basic *Crusader* design, the -26A takes over the Peace Patrol at nearly twice the speed of sound!

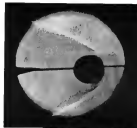
CHANCE  
VOUGHT



AERONAUTICS  
DIVISION DALLAS, TEXAS



\*These markings are representative of the six Navy and Marine squadrons flying *Crusaders*.



**SPRING** at Mach 1.51 (left) shows laminar combustion wave (light) and shock shock (dark) wave attached to front surface. Schlieren photo was taken in National Bureau of Standards experimental program. Instantaneous combustion during at the front of flame at right using slanting hydrogen mixture at Mach 4.90 shows the high frequency of the combustion in time, dashed lines.

## Supersonic Combustion Probed

New techniques for studying super sonic combustion by photographing the light of small fluorescent needles through carefully gassed but have developed at the National Bureau of Standards.

Fall results from the experimental method revealed schlieren pictures of laminar combustion in a supersonic gas stream, probably the first time the phenomenon has been photographed.

Application of the method will provide insight into the problem of sustaining combustion waves on vehicles in order to reduce the drag or increase the thrust in external burning. Data for the design of flame holders for supersonic combustion could also be one dividend of the program.

#### Supersonic Combustion

Supersonic combustion has been studied in the past by using shock tubes, shock flares, and free jets.

The Bureau was some of these results have been ambiguous and that the shock tube experiments can't be transferred to the conditions of a burning gas stream and a stationary wave on a fixed object.

The Bureau's approach, devised by E. M. Rapp, of the combustion control group, is to establish the shock wave ahead of the mixing nozzle, and then to induce combustion. Stagnation temperatures are relatively low and results are not affected by mixing methods or turbulence.

After studies of 3.75-in. diameter jets, fuel rates a mixture of hydrogen and air at Mach numbers between 3.2

and 6.5. Combustion was started by compression and heating in the shock wave standing in the nozzle.

One set of tests showed that constant gas flow steady around Mach 4 with separate shock and laminar combustion waves established in the leading surface of the sphere. But at about Mach 5 combustion became intermittent and at

higher speeds the wave appeared to be a strong detonation wave which originated into a shock and a laminar combustion wave.

At pressures of 3 and 4 atmospheres, stagnation temperatures in the detonation wave increased to 1,000°C and 1,000°C respectively due to the nozzle speed.

Frequencies of this intermittent combustion were estimated at 500 cps.



## Breguet 941 STOL Prototype Takes Shape

Prototype of Breguet 941, French STOL (short takeoff and land) aircraft, is out of egg for construction work on progress ahead at last night and April. Type 941 uses modified propellers designed to reduce short takeoff and landing during the airplane from low thrust propellers shown by Breguet's Taurus BE 10 technology engines. Changes in concrete showing markings of Type 941 a parabolic propeller moving forward, in perspective, with the engine. Type 941 would carry 10 passengers, or in alternate of 40 passengers and 800 lbs. of cargo, or a landing with cruise consumption of 9.5 lb./hour.

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17102



Agents: Ottawa, Ontario, Cleveland, Dayton, Detroit, Fort Wayne, Fort Worth, Hawthorne, Houston, Kansas City, Milwaukee, New York, Chicago, Philadelphia, Philadelphia, San Diego, San Francisco, Seattle, Toronto, Tulsa

## French Control System Monitors Flying Speed

Approach control system that monitors the flying speed of an airplane and maintains it at a constant value is being developed by Sagem, French national engine factor.

System is built around steering the turbojet exhaust nozzle to vary thrust as required to maintain constant flight speed. Experimental flight tests have been made with the delta-winged SE 212 "Demodol," a prototype light-weight interceptor, and the Dassault Mirage III delta-winged interceptor in preparation for the French air force. Powerplants used in both airplanes were SNECMA Mar 9 engine rated at 12,500 lb thrust with afterburning.

## Cambodian Air Force Buys Two Alouette Helicopters

Cambodia air force has purchased two Sud SE 119 Alouette II helicopters and plans to buy eight more for use in aerial ambulances. Helicopters are available.

Pilot and mechanics have been trained at Phnom Penh. A French air force officer has been assigned to Cambodia for technical assistance. Logistics air force personnel acquired two Alouette II for inspection work.

## PRODUCTION BRIEFING

German Aircraft Engineering Corp. secured a \$17.7 million Navy contract last week for continued production of the S2F-4 subsonic aircraft.

Federal Electric Corp., a joint division of International Telephone and Telegraph Corp. (NYSE: ITT) and Bell Telephone Co. (NYSE: BELL), has been awarded a \$1.5 million contract for the design and construction of the No. 1000, 1000th of the Apollo Guidance System for the next three years.

Sperry Univac Engineering Division of the Sperry Rand Corp. secured a \$1,150,000 Army contract for continued research and development of the Sperry Univac system.

Research Division of Ceres Wright Corp. has been given over \$500,000 in contracts for research, development and production of thermoelectric energy components for nuclear reactors, including components for the TOS (Thermal Oscillation System) reactor.

Aciplex-General Corp. secured a \$1,140,000 Army contract for production of rocket motor for the Hawk.

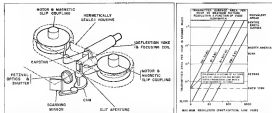


## These are men you should know DELANAN FUEL INJECTOR SPECIALISTS

These men are Warren Ferguson and Robert Triplett. Ferguson is General Foreman of Delavan's Marketing Division. Triplett is General Plant Superintendent. They have equipped Delavan with the men and machines to build fuel injectors to the most demanding tolerances. All designs are cleared with Bob Triplett before drawings are released for production. You can be sure Delavan can manufacture the fuel injector you need. These men and Delavan's staff of project and sales engineers use the state-of-the-art testing, jet, jet, jet, and APU manufacturing only on Delavan.

If fuel metering and atomization are part of your product, take advantage of Delavan's specialized experience and proven ability to deliver quality products at high production rates. Send specifications to the address below for quotation. Free consultation only.





**ELECTROSTATIC TAPE** assets films which record images on plastic tape by means of electrostatic charges, outlasts many of the advantages of magnetic tape and photographic film without sacrifice of its speed applications. New images developed by Radio Corporation of America will be used as Nimbus meteorological satellite. Surveillance coverage of each surface which can be transmitted per hour from a reconnaissance satellite is shown at right as a function of desired resolution and available satellite transmitter radio bandwidth as these coverages are prepared by Radio Corporation of America's Aero Electronics Division. Larger number of ground stations, permitting longer periods of transmission, reduces satellite bandwidth for given coverage.

## Nimbus Will Test Electrostatic Camera

By Philip J. Klass

Princeton, N. J.—New type of camera for satellite use, which records images electrostatically on plastic tape, is being developed here for the National Aeronautics and Space Administration's advanced meteorological satellite, Nimbus, by Radio Corporation of America's Aero Electronics Division.

The new "electrostatic tape camera" provides an image recording technique which combines many of the advantages of magnetic tape and photographic film without sacrifice of their disadvantages for space applications.

For example, the new camera's plastic

film has a data storage capacity which is considerably greater than that of magnetic tape and is comparable to that of photographic film. But like magnetic tape, an on-board thermal processing is required to read out the image. The image can be stored for extended periods, yet can be instantly erased if desired and the plastic film reused.

The electrostatic recorded plastic film could be retrieved from orbit as a recovery capsule without danger of damage by Van Allen or other radiation to which photographic film is vulnerable unless heavily shielded, or the image can be read out electronically and transmitted by radio to the earth.

The electrostatic recorded image is read out by an electron beam which can scan at extremely high speed, providing very large bandwidths without the mechanical complexity now required for traditional magnetic tape systems, according to RCA scientists.

Readout does require the stored image but fast or more accurate readout can be made before there is significant loss of detail.



**FIRST READOUT** of television test pattern image stored for four days on electrostatic film, shown left, reveals good detail and full-frame reproduction. Second readout, shown right, immediately following first shows very slight loss of detail.



**ELECTROSTATIC TAPE** consists of transparent plastic film, coated with thin gold layer, then a photoconductor and an insulator which stores charge pattern of image under illumination, according to RCA. Although not required for the NASA Nimbus application, the electrostatic camera holds promise of extremely high resolution, according to Richard Collins, manager of imaging and video systems for Aero Electronics Division. This unit gets that the new image-recording technique could find use in military reconnaissance vehicles.

Weight Air Development Division's Reconnaissance Laboratory is actively pushing the development of image recording techniques which do not use conventional silver halide emulsions which are vulnerable to radiation from Van Allen belts and nuclear explosions (AVW Aug. 3, p. 77).

The factor which limits the resolution of the electrostatic camera is not the grain of the recording medium, as it is with conventional photographic film, but rather the minimum obtainable diameter of the electron beam which is used to read out the stored image.

A operational model of the new type camera have been constructed to test the principle and a fully operational model is expected to be available within nine months.

A strengthened version, suitable for use in satellite use, with resolution equivalent to that obtainable with photographic film, could be built by the summer of 1962, if RCA got the go-ahead today, according to Horton Kravitz, vice president and general manager of Aero-Electronics.

### How It Operates

Although RCA's electrostatic camera and General Electric's new diagnostic recording technique (AVW Nov. 18, p. 57) both use plastic tape as the recording medium, the two techniques are fundamentally different.

GEC's diagnostic recording uses plastic tape coated with a transparent conducting film on top of which is a half-inch layer of a thermoplastic film. Information is stored as the three-layer film is moved by an electron gun which produces a varying pattern of charge. The film then is subjected to




**COMPARATIVE DETAIL** that can be obtained with two different optical resolutions is shown in these photographs of New York International Airport. Photo above has resolution of 50 line pairs per inch, while that below is 100 line pairs per inch. Photographs were made using a simulator developed by Radio Corporation of America which permits optical plots to be viewed with a wide range of resolutions.





# This is systems capability at NAA-Columbus

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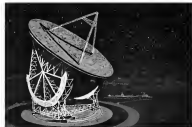
**NEW TARGET MODEL:** Two minutes in use, this unique target missile can carry out either high or low level missions equally well. It performs from subsonic through Mach 2 speeds, and from ground level to 60,000 feet. Under development for the Army by the Columbus Division, it is rocket launched, ramjet powered.



**GROUND LEVEL ESCAPE:** The first successful rocket-aided, ground-level escape system was developed by Columbus. In case of emergency it is equally effective on the ground or in the air... at landing or jet speeds.



**RESEARCH AND DEVELOPMENT:** Cryogenic research at Columbus led to the development of liquid oxygen systems for aircraft. Now one cubic foot of LOX can replace 842 cubic feet of gaseous oxygen.



**THE BIG "EAR"** The world's largest radio telescope reflector, 600 feet in diameter and more than seven acres in area, is being built by the Columbus Division for the U.S. Naval Radio Research Station in Green Grove, West Virginia. The 16-foot thick movable reflector will have a potential range of billions of light years.

the stored image can be made immediately or the tape can be reeled up and another made at some later time.

To convert the electrostatic image on the tape into electronic signals, which can be transmitted back to earth, the tape is used as one portion in that of an electron beam. This one unit is, tightly focused, an optimum resolution, in contrast to the broad beam used to produce the initial charge on the polystyrene surface.

The readout beam is aimed to scan the surface of the polystyrene modulator by a controlled electron-optical (or electrostatic) deflection plate. As the electron beam contacts each spot area, the amount of beam current that flows at that instant will be inversely proportional to the electrostatic charge level of that area and therefore directly proportional to the light intensity of the original image at that point.

The motion of the image by the finely focused electron beam results in a variation of charge differential between light and dark areas of the original image.

Is a demonstration for Aviation. When an image that was recorded on tape rather than on film was read out, first there was significant loss of detail.

To erase the electrostatically stored image, the entire polystyrene modulator surface is illuminated by a floodlight electron beam which equalizes the charge across the entire surface.

## Performance

The highest resolution of the electrostatic tape system is equal to that obtainable from conventional TV video cameras according to RCA scientists.

The quantum efficiency of the new electron photomultiplier is about 90%, making it comparable to photographic film in sensitivity.

A peak highlight exposure of 0.01 foot candles per second is adequate for photographing a standard FV 8-4 picture, according to RCA. With the use of electronic image intensifying techniques, now under investigation here, the electrostatic tape camera could operate at light levels only 1/75,000th as high. A laser-light image intensifier could cut required light level by a factor of perhaps 10,000, RCA believes.

The most significant factor in determining the resolution obtainable with the new electrostatic tape camera is the spot size of the incident electron beam. Considerable effort is under way at RCA in developing techniques for reducing beam spot size. One promising technique is to use a magnetically shielded cathode.

Company scientists here are confident that within several years it will be

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## Datacam Control-Display Link

Control-Display Link, called Datacam, between a data processing system and its input-output devices, displays input/output in alphanumeric form on cathode ray tube for inspection by human operator before transmission to machine or another device. Operator can approve, add or correct any of the displayed information before authorizing its transfer to data processing system or related devices. Datacam includes magnetic storage drum, built into desk cabinet, with capacity of 1,072 bits for storing information during inspection. Datacam can read and record data at approximately 1,000 characters per second. Manufacturer: The Electrodata Corp., Minneapolis, Minn.; Denver, Colo.; Salt Lake City, Utah.

possible to produce electronic tape camera that can satisfy the lighting, resolution of about 100 cycles per inch, per inch, obtainable with conventional photographic film.

Callas points out that the whole question of photographic resolution, in terms of being able to discriminate between different objects of interest, is neither well defined nor understood at present. (National Bureau of Standards has recently developed a new camera capable of projecting 50,000 lines per inch, to be used as a research tool for developing a standard method for characterizing the resolving power of photographic materials.) Because there is no such standard at present.)

## Imagery Simulator

RCA's Auto Electronics Division has constructed an imagery simulator which it uses for experiments to evaluate the effect of resolution, noise and speed electronic processing techniques on a human observer's ability to pick out important details from an aerial or satellite photograph.

The simulator can produce a TV picture with a resolution ranging from 120 to 1,000 lines. Noise can be adjusted to correspond to that encountered in radio transmission to determine its effect on interpretability. Callas points out the upper limit to stretch the gray scale of the picture, to bring out more detail or to enhance areas of equal

brightness (in darkness). This is particularly valuable in analyzing microscopical images of cloud formations to locate the most intense clouds. Other controls which differ outside the video signal producing a visual display which resembles a real map, this can be used to bring out details which might otherwise be lost in the image.

The Auto Electronics Division is also developing a new camera for producing photographs of radar information to be used back in satellite or ground receiving stations. At present this is done by recording data on magnetic tape, placing it back into a TV-type camera, then photographing the camera with a camera.

RCA believes that inspection can be performed as a single step by using an electron beam modulated by the received video signal, to record the picture directly on photographic film. (The same principle has been used in electron microscopes.) In this way the detection which occurs in the camera line and the viewing that occurs on the TV screen photograph will be eliminated. Here as with the electronic type camera, the resolution will depend upon the ability to obtain a focus on focused electron beam.

The division here is building an experimental model, using for such scale film, which is expected to be completed early next year.

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They're part of a Ballistic Missile Early Warning System (BMEWS). Officially, you'd call them surveillance radar antennas. Yet, they look like over-sized baseball mits. That web-like framework can detect (or spot) a far-off missile during through the shivering Arctic sky, and rife its speed and direction to any of our military bases in seconds.

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## Data Processing Advances in West Europe

Washington-Digital computer technology is the United States, quickly the large US military funding for defense purposes, is several years ahead of data processing in Western Europe. But West European scientists are doing excellent work in computer theory and concepts, and their industry outpaces ours as it has in the U.S.

Then it is the appraisal of Isaac Auerbach, top computer specialist who has just completed a seven-week mission of West European computer laboratories and facilities under the sponsorship of the Office of Naval Research. Auerbach, who heads a computer detection engineering firm serving the navy, did not visit Russia during the trip.

### Program Budget

Asertech's sales within second to the U.S. at present is the status of a computer technology, but experts Rana will be number two within five years. Germany and Japan also are moving up fast, he says.

Asachukh also reports that the Russian government continues to attract the Russians with their specific development of computer technology. One year after

The area of information processing is vitally important to every nation, Ansbach says. "There is no doubt that the quantity of a country's information processing system is as valid an index of its economic progress as, for example, kilowatt hours of electric power or tons of steel in production."

Research in pattern recognition and self-learning machines is widely used in some West European countries, as in the U.S., Auerbach reports. Among the most interesting programs cited by Auerbach were the following:

• **Alpha-synuclein character recognition**  
 (may use of technique which recognizes imperfections in the character or deviation from the idealized character shape) is under investigation at Technische Hochschule Karlsruhe, Germany. Total of 19 measurements made in the character is used around a constant matrix (e.g. reference) to identify the character. Technique is based on principle of measuring character shape by the potential gradients in shape profiles.

• **Tokyo: Hiroshi Vano** is experimenting with magnetic coils to attempt isolation of conditioned reflexes.

• **Seltronic Electronic Group, Ltd.,** Britain, has developed a device capable of reading hard type face characters at a rate of 240 per second, and rate can be increased up to 3,000 per second, *Amesbury was told.*

### Storage-Medium

[illegible]

## West European Computers

Major computer manufacturers and laboratories in West Europe, and the names/designations of computers they produced or run, have in development, cited by Hans L. Amelsch, include the following:

► **CREAT. INSTANS**

- **386 Computers, Ltd.** 386-1 II and III
- **Printers, Ltd.** Mark II Printer II II Monitors, Printers, Scanners, Fax, Office and Audio
- **Electronics, Ltd.** 402, 403, 404, 405 and 505
- **EMI Electronics, Ltd.** EMI/DEC 1100, 2400
- **International Computers and Telephones, Ltd.** 1202, 1300
- **Standard Telephone & Cables** STANBIC Zetes STANBIC Series
- **Solution Electronic Group, Ltd.** Microsoft, Spont 58
- **English Electric Co. Ltd.** New Design
- **University of Cambridge** Micro

## ► POLYMER

- \* Compagnie des Machines Bull - Groupes 3, Groupes 60 and 100 DF  
 \* Société D'Électronique et d'Automatisme (S.E.A.) - C.A.B. 920, C.A.B. 1010, S.F.A. 1000 S.F.A. 1000

#### • WHAT IS CEMENT?

- Strauss & Fiske: 2003
- Tetschelen: TR-4 TR-5
- Olney: Wicks, Danga
- Michael Elvik: Løkke, TR-66

- **ZOO** Z12, Z21, Z31
  - Max Planck Institute für Physik Mensch-G3
  - Technische Hochschule Darmstadt FERG
  - Technische Hochschule München FERG
- **ITALY**
  - CERN/LEA 5050, LEA 6050
  - University of Pisa CEF
- **SWITZERLAND**
  - Swiss Federal Institute of Technology ERNETH
- **THE NETHERLANDS**
  - N. V. Elektrotop N1
  - N. V. Fluigat Fland, Steris, Moon Lins
  - Midland-Nieuw Centrum Amers, Fortis
- **SWEDEN**
  - Fun Film E202
  - Akademierna för Vetenskap A.B.N.1 Wogrenstr 100
  - Swedish Board for Computing Machinery Red
- **DENMARK**
  - Reproduktion: Dansk. Gen
- **AUSTRIA**
  - Technische Hochschule Vienna Maschinen (Engl. text, 444 pages) book, a special computer market's special and capacity oriented with the U.S.





1. When searchers start detecting an enemy submarine, a ship-based computer automatically classifies the sub's course, range and speed — then aims the missile launcher. Upon command, a rocket-propelled ballistic missile is fired.



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Development of ASROC started with an idea and test of thousands of handwritten equations. Hoping to find the answer, the Bureau of Naval Weapons gave Honeywell, at great expense, the responsibility of designing, developing, testing and producing the entire system under technical direction of the Naval Ordnance Test Station.

The ASROC concept was based on present knowledge at the time the program was started, but it remained for subsequent programs, created not by the Navy-Honeywell team, to develop ASROC from idea to hardware.

Early in the program, prototype missiles were test fired manually and from moving platforms at the Naval Ordnance Test Station to obtain speed-of-sound measurements. Engineers measured, recorded and computed data and distances for about 100,000 surface measurements and plotted charts.

Hydrodynamic information was obtained from dummy projectiles fired into the water from a test stand and dropped from airplanes into a hydrophone range. Calculations on trajectory, hydrodynamic resistance and shock wave pattern enabled us to design. Throughout the development program, more than 100 test firings were conducted.

The result is an integrated weapon system consisting of an underwater sensor detection device, an electronic digital fire control computer, a missile launcher, the ASROC missile and all necessary firing equipment.

The facilities of 30 Honeywell divisions are available for development of any complex control problems of missiles or aircraft systems and components. If you have a problem in the design of systems or components, call or write Honeywell, Military Products Group, Minneapolis 5, Idaho. In Canada, write Honeywell Controls, Limited, Waukegan Avenue, Leaside, Toronto 17, Canada.

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### Boeing Antenna Design Models

Models various for radio astronomy, scaled down from a 200 ft. diameter, a checked for Boeing engineers. At left is model of an 80 ft. radio front antenna used for satellite tracking. At right is another model of an 80 ft. satellite horn, and at upper center is corner section of a rotating radio telescope antenna.

After being built by Textron, Ltd. The Alfa will have a storage capacity of one million words, half of a provided by the front and matrix, the other half by magnetic drum. Information from the matrix will be its ability to "learn" which elements in the real matrix are not being used during any portion of the problem and to automatically transfer that information to a magnetic drum to make room in the matrix for other more frequently used commands.

### Wired Core Storage

Accutrack found considerable more interest in and use of wired core and associated memory storage in West Europe than in the U. S. In The Netherlands, N. V. Elektronica has developed a novel machine for automated wiring of two ferrite cores. Machine operates under control of a punched tape program.

Node-to-core, large capacity, no down access time unit being developed by Stenbeck Elektron, Leuven of West Germany, for handling air passenger reservations at British European Airways and Air France. The machine, called the K-10, employs 10 type leadless lines in which magnetic tape is stored. The K-10 has one access time to an air delay between elements. Each has built-in about 128 ft. of tape, each capable of storing three million

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been made at frequencies from 60 cps to 300 kc.

►Wideband Traveling Wave Tube—A previously limited traveling wave amplifier design which shows promise of providing bandwidths up to 40% at any frequency from L-band to K-band was described by three Hughes Aircraft scientists R. W. Eng, William Haver and M. V. Krasovskii. Experiment tube has achieved 30% band width with power output in excess of several Watts and 45 db gain. With liquid cooling, duty cycle up to 10% is possible using pulsed electron gun or up to 24% with a cathode heated gas anodes spotted. Tube employs rugged metal ceramic construction, permitting its use in airborne applications.

►High-Speed Analog/Digital Converter—An electron beam tube which can be used to convert analog voltages into eight-digit binary output at sampling rates up to 10 mc, was reported by M. H. Cornwell and R. W. Steen of Bell Telephone Laboratories. Tube was a silicon electron beam which is electrostatically deflected in rapid switching voltage. Beam impinges on a grid plate containing eight columns of holes which correspond to binary equivalent of the analog input voltage. Output collector electrodes can be switched column, produce output results of 50 microseconds in peak to peak.

►High Power Microwave Duplexer—A broad duplexer which can switch seven megawatts of incident peak power with low noise and short recovery time at the rate of one RF cycle was reported by Dr. M. P. Teresi of General Electric's Microwave Laboratories. In new duplexer, switching is accomplished by secondary electron emission instead of the primary, and an discharge principle. Power reported that new duplexer has been operated for over 1,500 hr without signs of degraded performance, considerably longer than lifetime of conventional duplexer. Unit can be built for frequencies between UHF and X-band, with bandwidths of 1%, which are feasible over 10% of band.

►Increased Master Gas-Bandwidth—Experiments that confirm earlier advised theory that the negative resistance and reactance of a solid state mixer can be advantageously used to increase the gas-bandwidth product of a coupled circuit system were reported by E. V. Gaudin of Hughes Research Laboratories. A tube mixer operated at X-band in push pull mode with a capacitance Q of 50 with a gas-bandwidth product of 100 mc has demonstrated



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**LONG RANGE INPUT/1794** / News of the launch of the *Autonia* was spread to the French Revolutionary Convention at Paris in a matter of minutes via Claude Chappe's amazing telegraph system, or relay aerial telegraph, Sept. 1, 1794. A new era in rapid communications had begun. / Today, instantaneous and completely reliable Electronic Communications insure the immediate and continuous advantage of intelligence throughout the Free World. ECI is proud of its initiative and responsibility in the design, development and manufacture of high precision electronic equipment to the highest specifications required in various aerospace and surface roles vital to our National Defense and to scientific advancement. An example is *Autonia Long Range Input*—a program where ECI communications and data link equipment fill an integral and essential requirement in linking USAF's advanced early warning system to SAGE—our command and defense network.

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single-wire operation, showed gain bandwidths of 350, 490 and 1,890 mc for amplifier gains of 28, 38 and 40 db, respectively, when two active control elements were used in a differential circuit. Gooden reported. When applied to bonding-wire mixer, the conventional 50 mc gain bandwidth can be increased to 193 mc by using two diodes. With four diodes, the product exceeds the rule line width and typical bonding-wire mixer characteristics were observed. Using six diodes and a struct bias provided of 380 mw, centered at 3,700 mc, a gain of 36 db and an amplification bandwidth of 25 mc were obtained. Rule was cooled to help temperature of 4.2K for tests.

#### NEW AVIONIC PRODUCTS

• Type-programmed busbar analyzer, Model 150, checks cable harness for continuity, linkage from wire order list to all other wires, and short circuits. Analyzer provides automatic print-out to indicate short circuit and linkage identification to all points covered wire identification and branch circuit identification.



flexion. Analyzer in basic configuration can handle 680 wires (1,208 points), or can be expanded to 5,760 wires. Manufacturer: California Technical Industries, 1421 Old County Road, Belmont, Calif.

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accepts .305 to .335 variations in TO-5 cases!



IERC Transistor Heat Dissipating Radiator needs no immediate dissipation variations up to .001" from 10-6, 10-5, 10-4, 10-3, 10-2, 10-1, 10-0, 10-1, 10-2, 10-3, 10-4, 10-5, 10-6, 10-7, 10-8, 10-9, 10-10, 10-11, 10-12, 10-13, 10-14, 10-15, 10-16, 10-17, 10-18, 10-19, 10-20, 10-21, 10-22, 10-23, 10-24, 10-25, 10-26, 10-27, 10-28, 10-29, 10-30, 10-31, 10-32, 10-33, 10-34, 10-35, 10-36, 10-37, 10-38, 10-39, 10-40, 10-41, 10-42, 10-43, 10-44, 10-45, 10-46, 10-47, 10-48, 10-49, 10-50, 10-51, 10-52, 10-53, 10-54, 10-55, 10-56, 10-57, 10-58, 10-59, 10-60, 10-61, 10-62, 10-63, 10-64, 10-65, 10-66, 10-67, 10-68, 10-69, 10-70, 10-71, 10-72, 10-73, 10-74, 10-75, 10-76, 10-77, 10-78, 10-79, 10-80, 10-81, 10-82, 10-83, 10-84, 10-85, 10-86, 10-87, 10-88, 10-89, 10-90, 10-91, 10-92, 10-93, 10-94, 10-95, 10-96, 10-97, 10-98, 10-99, 10-100, 10-101, 10-102, 10-103, 10-104, 10-105, 10-106, 10-107, 10-108, 10-109, 10-110, 10-111, 10-112, 10-113, 10-114, 10-115, 10-116, 10-117, 10-118, 10-119, 10-120, 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10-1329, 10-1330, 10-1331, 10-1332, 10-1333, 10-1334, 10-1335, 10-1336, 10-1337, 10-1338, 10-1339, 10-1340, 10-13

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or six 9-pin) magnet units in 0.6 inch increments with extremely linear output. Motor, Type 9091-06, measures 4 in. diameter, provides virtually no change in speed over temperature range of  $-50^{\circ}\text{F}$  to  $160^{\circ}\text{F}$ , according to manufacturers. Motor is available with gas train ratio of 6.1 to 46,696:1. Motor can handle up to 160 oz. in peak loads. Manufacturer: John Oster Motor Co., Arroyo Del Rio, Rancho, Wis.

• **Conductor multiconductor cable** only 12 mils thick and accompanying connector device for use in radiofrequency cables, to reduce joint connections and to provide end and ground data connections. The flexible cable is available in different patterns for temperatures from  $-60^{\circ}\text{F}$  to  $+250^{\circ}\text{C}$ . Up to 34 conductors per inch can be assembled in a single cable for radiofrequency applications. Hughes Aircraft Co., Industrial Systems Division, International Airport Station, P.O. Box 99944, Los Angeles 45, Calif.

• **Titanium potentiometer**, Model 550, can withstand environmental extremes set by MIL-R-7220, operate at temperatures up to  $+200^{\circ}\text{C}$  and is potential against humidity and corrosion by existing soil. Pot is rated at one watt and has 5 in. Teflon covered wire leads. Resistance range is 10 ohms to 50 kilohms. Manufacturer: Heraeus, Inc., 12660 Plummer St., Los Angeles 66, Calif.

• **High temperature diacretic detector**, penetrable diacretic type CMA-731, can operate up to  $+500^{\circ}\text{C}$  with no detectable change in electrical or physical characteristics. Diacretic constant is 30 at frequency of 25 sec. Mutual provides more than 18 db/Aw attenuation at 5,200 mc., or 26 db/Aw at 14,000 mc., has a density of 4-65, can be machined or molded. Manufacturer: Custom Components Inc., Colver, N.J.

• **Backward diodes** for use with tunnel diodes in logic and other computer circuits, in low level oscillator and detector circuits. Leakage current is 500  $\mu\text{A}$  with and forward voltage is at 15% of maximum tunnel diode's peak current. Forward voltage drop is guaranteed not to exceed 33 millivolts, typical drop is 15 millivolts. Application

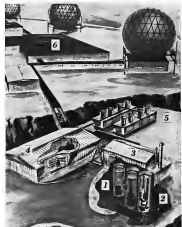
notes containing tunnel diode and backward diode circuit designs can be obtained from the manufacturers: Texas Instruments Corp., 165 Alton St., Wickliffe, Miss.

• **Wideband high relay**, Series 123, reportedly can withstand vibration of 50g to 2,000 cps and shock of 30g when de-energized or 100g when energized with no contact spacing. The hermetically sealed relay, measuring 31 in. in diameter by 14 in. long, has contacts rated at 5 amps for either 115 vac or 24 vdc for 30,000 operations, or one amp for 14 million operations. Leads are designed for printed board mounting. Operate time is 5 milliseconds and re-



lease time is 7  $\mu\text{sec}$ . Relay meets MIL-R-7377C and MIL-R-25938, according to manufacturers: Wheelock Signal, Inc., Long Beach, N.J.

• **Frontband video detector**, Type MA-4H, for high temperature operation covers out over the 40,000 to 75,000



### First Nuclear-Powered Radar Installation

Nuclear's first nuclear-powered radar installation, to be constructed for Air Defense Command ship 6,000 ft high Warner Peak near Sandusky, Wyo., will generate 1,000 kw. of electric power and supply steam for heating facilities. The Martin Co. is responsible for design and construction of nuclear powerplant. Key elements in the installation include (1) two sodium core chambers, 36 ft high, dug into earthside, (2) heat transfer system for circulating steam from water circulating through core, (3) reactor building, (4) turbine generator, (5) turbine condenser, and (6) valve operating building. Facility is scheduled to become operational by May 1962.



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mic frequency range, has maximum sensitivity of -27 dbm over entire frequency range for receiver bandwidth of 3.5 mc and 100 kc. low frequency cut-off. No external filter is required, with construction provided for several types of waveguide. Manufacturer: Microwave Associates, Inc., South Ave., Burlington, Mass.



• Stokas page, Model SCE, also available with complementary portable bridge control module, Model BCRI-Q. The subminiature stage gate has static range of  $\pm 0.001$  in./in., page length of 1.25 in., accuracy approximately 1 in. and accuracy 175:1  $\pm 0.01$  in. Gate provides infinite resolution with combined readout and systematic error of less than  $\pm 0.10$  of full scale. Stokas Instruments, Inc., 37481 W. Olympic Blvd., Los Angeles 64, Calif.

• Miniature feed-through capacitor, offering high thermal shock resistance, rated at 200 vdc. over temperature range of -150C to 150C, is available in clove-tinned brass case in three capac-



torance values: 820, 1,000 and 3,300 pF. Application data is available from manufacturer: King Electronics, Inc., 915 Mendota Ave., South Pasadena, Calif.

• High temperature voltage reference, Series 250, operates from unregulated 25.5 vdc, provides output of 5.0 to 8.5 vdc, with regulation of 0.005% for a 10% line voltage change. Temperature coefficient is quoted at  $\pm 0.001\%$  per degree centigrade from -150C to 150C. Device also provides low inductance output terminal. Voltage reference is packaged in miniature crystal case, measuring 5 x 3 x 11 in. for installation in standard relay sockets. All semiconductor elements used in silicon. Manufacturer: Viking Industries, Inc., 21345 Roscoe Blvd., Canoga Park, Calif.



• Miniature crystal filter, with volume of less than one-half cubic inch, has a center frequency of 10 mc, with 2.5 db bandwidth at 9 db point and 20 db at 40 db. Insertion loss is 1 db. Devices are available with center frequencies of 10 kc to 85 mc. Manufacturer: Electronic Laboratories Corp., 4218 Spencer St., Tempe, Calif.

• Gamma-ray tunnel with peak current of 1 ma. or 3 ma., peak current tolerance of 2%, 5% or 10% and peak-to-average ratio of 8:1 are now available for operation over temperature range of -150C to 150C. Capabilities can be produced per subprogram. Manufacturer: Transonic Electronics Corp., 168 Albion St., Woburn, Mass.



• Digital light indicator, Type TDC, for monitoring in digital circuit operation or backscattering logic device, contains 10 parallel digital circuits with logical symbols identifying input/output connections and their functions. Specs. by Components Division, 275 Main Ave., Cambridge 39, Mass.

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## NEW DEPARTURE

MINIATURE AND INSTRUMENT BALL BEARINGS



***General Electric  
Silicone Rubber  
finds dozens of  
uses in missile  
systems. How  
many more  
will prove vital?***

General Electric silicone rubber can be "dressed" with a "thermal brightener" to stand up under the scorching heat of rocket blast and is possible atomic attack. Also very good electrical properties and excellent resistance to aging, with better mechanical strength, are obtained. The brightener is a new, low-cost, why silicone rubber is now being used in virtually every U.S. missile and space vehicle.

GEBC, both space technology and silicon rubber, are relatively new. Clarence E. Clarke, GEBC's president, says, "More and more, as we get explored where silicone rubber can help bring a mission functionally reliable and cost-effectively. To help support it, there's tremendous work, not just in the U.S. but in Europe, Japan, and elsewhere of G.E. silicone rubber."



**RTV LIQUID SILICONE RUBBER**—One of the most versatile materials developed in recent years, RTV is a liquid rubber that cures at room temperature. Like all silicone rubbers, it remains flexible over a wide temperature range and is virtually ap inert. Known to cures in a wide range of situations, it can be poured, sprayed, dipped, painted or applied with a pressure gun or syringe. It bonds lightly to metal when a primer is used. When not primed you can readily remove RTV and then reapply more. You can incorporate highly wound rods with RTV or form springs around carbon fiber.

You can control your time from two minutes to 24 hours. There are RTN's typical perspective.

Viscosity	From 100 poise (very possible) to 12,000 poise (possible)
Specific Gravity	1.2 to 1.3
Bulked Content	100%
Storage in	50%+
Heat Resistance	From —30°F to

David Robinson	For America
Michael Pennington	Comparable to Bill Clinton

**Agglutination-KITV** is used as a high temperature shrinkable coating in electrical insulators and space vehicles. It is used to pot and encapsulate electronic components and assemblies for electrical and heat insulating and for protecting delicate components from physical damage. It is commonly used as an encapsulating medium in transformer coils, to pot and hold cable in sockets and to pot cable hardware. This resin makes flexible molds with KITV and foam make numerous

RTV is an overlying thermal barrier and as such is applied on and around muscle wounds. Tests show RTV's resistance to flame temperatures as high as 1000°F for several minutes. RTV also functions as a flexible shatter material and is used around probe holes, along incisions, and between stages and structural joints on the muscle skin.



## HEAR (UN)O SECURONS RUBBER PARTS

• **Stiffness** rubber gaskets, port seals, O-rings, shock mounts and other mechanical parts are not only used on machines but have wide application in general support equipment. For instance, inside the door is a stiff rubber seal that will stand up to a crude weathering, noise reduction for privacy and which will also make the feel of a door firming and making it look like a solid rubber seal.

Silicone rubber has long-lasting temperature resistance from  $-150^{\circ}\text{F}$  to  $400^{\circ}\text{F}$  with excellent dielectric properties. It does not retain moisture and contains properties at these temperatures. High tensile strength and low compression set are also within its range of desirable characteristics.

Lyalls Strength	900-1300
Marquette, Va.	100-600

Marathon Big contest	24-28
(Shore 40)	
Competition Set, 76	10-22
Time: 10:00am to 11:00am	40-1000
Marathon: 10:00am to 11:00am	1 x 1000
(Shore 40) 10:00am to 11:00am	See 10:00am



**WIRE AND CABLE INSULATION** — The long-term reliability of silicone rubber when operating in high ambient temperatures and when current overloads cause the conductor to approach 300°F is an important feature of silicone insulation. In a 1800°F flame, specially cross-linked silicone rubber insulated cables will continue to insulate for hours, forming a non-conductive ash that drops or is blown away. And short-term reliability is assured even when silicone rubber is exposed momentarily to a direct flame of 3000°F.

Because of this excellent heat-resistance, most polymers can be recycled into a conventional waste (or smaller solid can be used). Other features: heat resistance of all thermoplastics at temperatures exceeds 100°C; that of some rubber was and waste does not deform under stamp high stress, stress, radiation and weather resistance, low moisture absorption. Heat stability down to  $-100^{\circ}\text{C}$ . These are the listed properties:

Salmon fecundity	$10^3-10^4$
Salmon's length	400-450

Ballistics (Continued)	28
Bill app	

Fourier Transform	0018-0400
Acoustic Resonance	1 x 10 <sup>6</sup> iterations
Physical properties	Similar to table above

[illegible]

There are many more places where G-6 silicon rubber-lined industrial properties can be added to monomers, satellites and space vehicles. For further data, call/purchase G-6 sales office or write: Section 21183, Office Products Department, General Electric Company, Watford, New York.

## SPACE TECHNOLOGY

## Control Center Guides Orbiting Satellites

By Cecelia Alexander

Operating as a space traffic controller, the USM Satellite Control Center (SCC), Sunnyvale, Calif., will direct all Discoverer, Midas and Samos satellites through orbit flow and display systems now installed and functioning at the facility.

With their rotors designed and developed by Radiation Inc., Millis, MA, under subcontract to Lockheed, the SCEC (4 W Max, 90 g, 577 sq ft) will be able to handle 20 to 30 satellites at a time, ranging from 100 to 500 sq cm, with periods of approximately 90 to 10 min.

Problem of content is complex, but the Radiation, Inc., system will process SCC with the capability of sorting and repurposing the pieces of stolen satellites over a tracking station within the next three to six months, so that an orderly assignment of transmission and reception of signals to overhead vehicle may be effected.

Focus point of the SCC and of Radco's systems is the control room where all data on the oilbearing offshore will be displayed on TV monitors, data and dynamic position systems, compass, windmill, charts and maps.

Personnel assignment of the routine work is still in the research and development stage, with several combinations of men and equipment being studied. Initially USAF, Lockheed and Radio Inc. are considering a "one team per satellite system" assignment, which would place all Discoverers under control of one team, all Maris under ground teams and all Samos under fixed

Each has its own set of instructions, test direction and an assigned test controller standing side by side on the control console. Responsibility of the controller ends and of the three utility controls is changed to a test direction, called by test controller, both sitting at identical control consoles. (Job titles are R&D designations and can be changed when fully staffed by USAF personnel). Controller personnel run all the test controller and assigned test controller slots.

Precisely, when a series of Diogenes, Mide, and Simon cavities are drilled, each team will maintain logs about all the locations of pipes which under its control, but will concentrate on that particular cavity which is a priority to it at present and/or future.



**FLYER PLAN** of the *SHARF* Seafloor Control Console shows the controls used with both diverter and dual controller master consoles (15), auxiliary diverter controller lines (control 12), right tactile and dynamic proportion screens (13), and proprioceptive controls, containing 20 tactile and dynamic progressors (14). Montage together console (15), teleports, three TV cameras and monitor (16) are housed in the average room. Operations and planning console contains the 36 tactile buttons (7), the type graphic screen (18), and the dynamic pilot control (19). The TV monitors and monitor (16) are mounted on a swivel stand for the equipment room. This drawing, finished in early film plan, showing a total of 16 projection screens and 35 progressors.



**ASSISTANT** Just beneath the console's controls, there's 17-in. TV monitor and all controls necessary to select and display information from data base and display system developed by Radiation Inc. Work here beneath TV monitor are two display tubes. Bottom panel at left of console contains communications links. Most at right of console is a transceiver panel with TV camera installed; upon which messages may be written and transmitted to other parts of the Satellite Control Center. Pneumatic lines and terminals are located beneath the center portion of the console.

*Progress Is Our Most Important Product*

GENERAL  ELECTRIC

## New Ways To See Fire...



**Fenwal**

DETECTS TEMPERATURE . . . PRECISELY

Fenwal has developed two advanced methods of finding fire or overheat faster in aircraft and missiles.

Fenwal's FIDO (Fire Inspection Device Optical) permits a pilot to visually monitor potential danger areas from a remotely located control panel. He merely looks into a tube containing FIDO's optically oriented glass fibers to see the hidden area. Or, FIDO can be used by launching crews to check out blind areas in missiles and rockets. *Image resolution is as fine as you demand!*

Fenwal's Surveillance Detector sees fire or overheat that may occur in large volumes, eliminating the "inlets" that may be present when point or line detection is used. It operates photoelectronically and is sensitive either to the first flicker of a flame or to heat radiation. It is "blind" to daylight and even the direct rays of the sun — it "sees" only the potential danger!

These advanced Fenwal safety devices are the end products of long and continuing research. They complement Fenwal's established capabilities in unit and continuous detectors, and explosion suppression. A Fenwal engineer will gladly supply details. **FENWAL INCORPORATED, 2115 Pleasant Street, Ashland, Massachusetts**



### Soviet Rocket Chief

Marshal Nikolai Leonovitch Mikhovskiy has been appointed the new chief of the Soviet Rocket Command, according to Marshal Mikhail I. Nikolov who was killed in a recent rocket crash in the Soviet Union.

Information from the ground stations (Information from tracking stations is beamed into the SCC by about 100 type telephone voice lines and radio links) goes through computers, is sorted according to satellite status and then referred to the appropriate team in the control room by closed-circuit TV projection screens and personnel lines. The director-mathematicians then make the data decisions and make and commands sent to tracking stations for transmission to the craft.

Since operational needs of the Vodka and Sorex vehicles will be kind with suitable Agen engines, some of the more important decisions that might be made will include changing satellite orbits for more flexible surveillance and grouping of several vehicles for either more comprehensive coverage of wide areas or greater detail on a specific object.

At his console, each director will find three 17-in. closed-circuit TV monitors and controls, communications panel, time display including Greenwich

# OPERATION OVERHAUL



*Our choice for jet-engine pre-cleaning at Ulica Division of Curtiss-Wright is Ferlon,<sup>®</sup> and here's why:*

*by Dean E. Shieh\**

"We needed an alkaline pre-cleaning solution that would remove stubborn scale, rust, carbon, grease, oxidation, carbon deposits, and lead deposits prior to removal of heavy heat scale and anodes from jet-engine parts. We wanted to reduce cycling time substantially, and extend the chemical life of more expensive solvents."

"Wyandotte Ferlon has reduced cycling time on all parts, and cut the cost of subsequent rinsing. It is an excellent rust remover for damaged parts . . . has saved considerable labor in cleaning ferrous parts . . . and has shown no evidence of injury to parts processed. It has reduced repairs for improper cleaning to a minimum, and paid for itself many times over."

May we demonstrate these points to you? Call your Wyandotte representative, or write to direct:

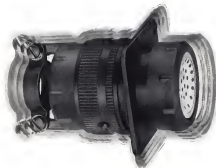
Wyandotte Chemicals Corporation, Wyandotte, Michigan  
Also Los Angeles, California and Atlanta, Georgia.  
Offices in principal cities.

 **Wyandotte  
Chemicals**

**J. B. FORD DIVISION**

\*Hendelgalt  
Curtiss-Wright Corporation  
Utica (Michigan) Division

The best in chemical products for metal finishing



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**Reliability for Industry • Aircraft • Space Vehicles.** Cannon's full line of vibration-proof plugs are engineered to meet the most stringent demands of industry, missiles, and aircraft. If you have a problem in vibration, let us provide the answer. From umbilical plugs to the most versatile submountures... for any ground or airborne use, Cannon vibration-proof plugs surpass what is expected of them. Another reason why you should always consult the first name in plugs... why you should consult Cannon for all your plug requirements. For information on these or other Cannon products write to:

**CANNON ELECTRIC COMPANY,** 3800 Humboldt St., Los Angeles 31, Calif.

**CANNON  
PLUGS**

Missile Time is-time countdown and display, display for tracking and reporting messages, writing desk, for transmission of messages over the TV circuit, and pneumatic lines and controls for transmission and reception of messages.

The TV circuit, a high resolution 100 line system, poses the director's three console members to 16 station boards located in the operation and planning areas, adjacent to the control room and four telephones located in the message room also adjacent to the control room.

The station boards are essentially light boxes, with TV cameras mounted on the bottom and focused upward. Charts, graphs and messages would be placed on the translucent vinyl tops of the boards and to project up on the screen. Of the 16 boards, four are assigned to each of the three satellite stations; the remaining four are to be used for such general data as weather, tracking station conditions, etc.

Four telephones—one for each satellite station and one for general communications—are also located in TV centers. The machines are probably part of a set including the Air Force's latest Model 15000 of Hughes, the Pacific Mobile Range headquarters at Ft. Meigs and the Launch Mod/Com at Vandenberg AFB, all in California; the tracking stations and the downrange telemetry ships.

Eight large projection screens, forming a circle from diagonal corners of the control room, face the director's console from three sides. Two—one static and one dynamic—are assigned to each team; the two end screens are to be used for such general purposes as system control (to determine position of satellites over a tracking station), satellite schedules (to show which vehicles are coming up next) and for special problems encountered by any team which might call for an additional screen to display the conflict.

The static screens will display the predicted orbital paths (ephemeris) of the satellites and will be compared with the actual tracks of the vehicles as real-time plots as displayed on the dynamic screens. The static projectors, although similar to conventional commercial models, are expensive multiple images of up to twelve miles on a single screen with a high degree of resolution.

The dynamic projectors are operated from tracking data received in the MCC from the ground stations. The data is first processed through a Control Data Corp. 1604 computer, unscrambled and the results read out on punched tape. The tape is then fed into a dynamic plot generator which translates the tape's binary code into the analog voltages necessary to drive the projectors.

In operation, the data flow and display screens would probably read like this: the actual and base plot of the satellite, as traced by the dynamic projector, would be compared with the predicted ephemeris on the static projector screen. If deviation is noted, the director/controls team would issue corrective commands to the tracking station to transmit to the satellites. Simultaneously, the team would be checking the information on the status boards via the closed-circuit TV loop on tracking station conditions and conditions equipment failure would have to be reported immediately, because of the short time intervals between passes of satellites' receivers from radiation (in the event of capsule recovery), weather, ground tracking and other status information.

If any discrepancies were noted between mission objectives and actual satellite performance, the director/controls team would initiate corrective action immediately. Should the discrepancy be major—majority loss of vehicle power—it is probable that the team would have to reevaluate the entire vehicle of that status to recall the day around in that vehicle's line, until such time as a replacement vehicle could be launched to take its place.

Although Discoverer is a research program, oriented with the space-based status of Nike and Gemini, it is assumed that this satellite are being incorporated into SAC's program for both open-ended research (scientific, technological and the development of current space technology) and ground personnel training purposes.

## USAF Tests Space Food Warmer

Minutia, N. Y.—Solar thermal radiation will constitute the sole heat source for a space vehicle food warmer now under evaluation by the Wright Air Development Division.

The solar space oven is the result of a WADD contract let to REP Industries, Minutia, N. Y., aircraft galley manufacturer, to develop an efficient food warming device that is independent of electrical power. Prior to this contract, the company developed an electric oven used in Project Hermes (NAVJAG 8, p. 95).

REP selected the solar-heated oven design after first investigating and discarding the possibility of chemical and nuclear powerplant heat exchanger methods. Excessive gassing and shielding weight in the nuclear method and flames and irreversibility of chemical reactions precluded the use of these heating techniques.

The operation of the space oven is three tubes of stainless steel concentric tubes. The Air Force oven that heating is necessary both to make the food more palatable and to reduce the moisture of canned food.

The thermal radiation collector surface on the 14-in. oven is a 1 sq. ft. magnetron plate. The magnetron is run on two ground-to-oven microwave lines with efficiency 40% the flanged collector surface on one side connected to the oven heating surface. The other side of the oven is a flanged magnetron door. This is designed to fit snugly against the oven's outer surface, thus conducting the thermal energy to all sides of the food to be heated. The solar oven is designed to operate in a spatial orbit in the vicinity of the earth. The solar flux at the earth's outer atmosphere of about 440 Btu per sq. ft. per sq. ft. should bring the food warmer to an equilibrium temperature of about 610°. On a Nike



MAGNETRON plate of solar space vehicle food warmer heats three tubes of food to 600° in 75 min.



# HEDGEHOPPING AT MACH 1

## Lockheed radar shows pilot how to miss what he can't see



When a pilot hugs the deck tracing a mile every four seconds, his route is the world's most dangerous obstacle course. Hills, bridges and other hazards can be in his lap before he has time to maneuver safely over them. He needs information well in advance, particularly in poor visibility or at night.

And now he gets it—down Lockheed Electronics terrain avoidance radar. A compact display shows him obstacles, his position in relation to them, and the maneuvers necessary to avoid them—in time.

Lockheed Electronics systems engineers have crisscrossed in one group of modules the most versatile airborne radar in flight test today. Equally effective as a map-

ping, bombing or navigational radar, this lightweight, transistorized unit is typical of the sophisticated equipments developed by Lockheed Electronics to help strengthen the nation's defense.

#### CAPABILITIES—MILITARY SYSTEMS/STAVID DIVISION

RADAR SYSTEMS—search, bombing, navigation devices and displays, missile guidance and control, automatic detection and data processing.  
COUNTERMEASURES—ECM, ECCM, active and passive jamming, weapon control and detection—ASW, electronic warfare detection, jamming and communication.  
SIMULATION AND TRAINING DEVICES.  
OPERATIONS ANALYSIS—offense and defensive systems, war operations, defense matters, electronics in space.

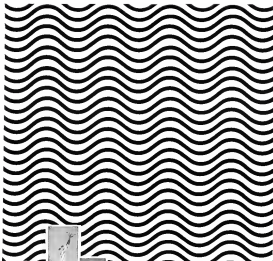
#### MINDING THE FUTURE

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The illustration above is a clever art illustration. The illusion of non-parallel quality that different brands of wire and cable give is also clear. To the skilled eye, they seem identical.

Most brands of wire and cable may be produced with similar materials and equipment. One brand, however, will outlast, outperform the others—Hitemp.

The reason Hitemp Hitemp has the greatest store of experience in the industry—two decades' production tests that are second to none—and more than one fourth

of its entire work force devoted solely to inspection and quality control.

Hitemp products are for you: the wire and cable user who requires quality and reliability that is test, not illusion.

Hitemp is a Division of Simplex Wire & Cable Co.

#### HITEMP WIRES CO.

1300 SHAMES DRIVE, WESTLEY, NEW YORK  
1632 S. CALIFORNIA AVE., MCNVILLE, CALIF.



version (with 216 lbs. per lb. per sq. ft. flux), the equilibrium temperature is 125°F.

Adding time for the specimen's load, in an earth orbit, will be approximately "9" sec. from take-off to orbit. A suitable 125°F. temperature is obtained by Toms' requirements prohibiting the use of electricity will depend on the amount of light radiations or automatic shield devices relied upon to provide for heat losses. In fact, the use of solar energy for heating is possible. Heat from entering one WAD specification, that of providing an earth control. The solar oven will operate when the vehicle is in orbit so that the collection relay is on the dark side.

One problem in obtaining direct solar energy for food warming is that the vehicle must be continuously oriented. A possible solution to this problem would be to mount three ovens 120 deg. apart about the space vehicle. This, however, could require much of the weight advantages of the solar heat system.

The solar heat system is equipped with the steel covers to provide operation in non-gravity conditions. Magnetic latches close the oven door and young dogs pass the food tubes against the magnetized surfaces to prevent any further heating. The absence of air within operates under zero conditions requires direct contact between the food tubes and the magnetized surfaces.

#### F-1 Turbopump Test Stand Nearly Complete

Los Angeles—Turbopump test stand for Rockwell's F-1 engine is now complete at North American Aircraft's Santa Barbara Mountain facility. The stand is a modification of a former propulsion test stand and will be used for checking and turbonomps used in certification of the F-1 engine, for tests in 10000 M.B. Cold.

Designated Buva II, the facility will have three test positions and is to be used for certification testing for class two testing and the third for research and development. Normal frequency of testing will be six tests per 16 hr. day with a regularity of six testing in eight tests per 16 hr. day.

Each test position has Buva II includes two 20,000 gal. liquid oxygen vessels and 100,000 gal. fuel vessel and 130,000 gal. water tank.

The turbopump, as the turbopump motor test will be operated in a gas generator driven by propellant supplied from Buva II tanks and other three engine propellant tanks for the turbopump being tested.

Each of the three test positions at Buva II has an afterburner to carry off gases generated by the tests.

AVIATION WEEK, November 14, 1969



## NEW PYLE STAINLESS STEEL MIL-C-26500 CONNECTORS\*

### True Connector Reliability

Here are miniature, lightweight connectors in highly resistant to corrosion of temperature, vibration and difficult duty. In providing, at last, true connector reliability for air, missile and space systems.

The stainless steel shell conforms with the Pyle-National connector... each connector is weight, with at least two times greater durability of wearing surfaces. An absolute corrosion resistance with no surface coating, maximum high strength in maximum operating temperatures.

\*Qualitative standard. Design has been adopted as Pyle Part No. 100-1000 (MIL-C-26500). Items for complete information.

#### DESIGN CHARACTERISTICS

- Crimp type, removable, integral contacts to MIL-C-26500, securely sealed and reinforced by metal shells.
- Contacts, fully protected against heat and shock damage, undisturbed against vibration.
- Right insert parts provide firm contact support, positive control of axial location and shear.
- Mounting flange bonded to shell. Wire sealing independent of cable clamp.

**P** THE PYLE-NATIONAL COMPANY  
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District offices and representatives in the principal cities of the United States  
Manufactured in U.S.A. by Pyle National  
Council Inc., Toledo 10

OTHER TYPES OF CONNECTORS IN THE MANUFACTURE OF INTERCONNECTING AIRCRAFT CONNECTORS



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SERVING THE AIRCRAFT INDUSTRY FOR OVER 40 YEARS

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With its conical nose, Zeus can intercept attacking missiles far from the area it defends.

## Zeus is designed for a hit every time on supersonic bulls-eyes!

At last, an anti-missile defense will have only a few minutes to react...and no "second barrel" to fire at its supersonic target.

Nike Zeus needs none. Tests of this new antipersonic missile show that it will attack enemy ICBM's with 180% accuracy at a distance interception point. There its nuclear warhead will be delivered to its hit.

the approaching ICBM with an explosive certainty.

The newest member of the famous Douglas Nike family, Zeus was developed in a joint Western Electric, Bell Telephone, Douglas Aircraft project. Its design combines the most successful lessons learned from Ajax and Hercules—Nike Zeus predecessors that are on duty around

many important U.S. cities and industrial centers and with NATO forces overseas.

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A DIVISION OF THE DOUGLAS GROUP

## Army Tests Toxicity Of Boron Hydride Fuel

Tests carried out by the Army Chemical Warfare Laboratories show that high energy boron hydride fuels and their boron oxide exhaust product produced toxic effects when applied to the skin and eyes of rabbits, rats, dogs and other animals.

The toxicity of these materials varied from one type of animal to the next. In rabbits, for example, lesions were caused by concentrated material applied to their wet bodies produced an inflammation, when inhaled and applied topically to untreated animals. The results led to significant changes in their tissue. Boron hydride appears to be a serious health hazard to rats, guinea pigs, rabbits and cats when they are exposed to it orally, inhaled and externally.

Dogs and cats, however, which are killed by boron oxide in animal form for periods up to 24 hours showed no signs of poisoning or irritation. The tests also showed that boron hydride was as effective flushed from the skin of test animals with a mild solution of ammonia, and the finding area is considered suitable for humans that may come into contact with the fuel. Surgical gloves, material and shrouds containing only limited protection according to the report.

Two reports on the tests, PB 161771 and PB 161772, are available at 50 cents each from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

## Arcas Rockets Study High Altitude Weather

Eight AFM, P-35 Series of 180 rocket space probes to study meteorological conditions between 100,000 and 250,000 ft. is being conducted here jointly by the USAF Air Proving Ground Center and Cambridge Research Laboratories, Bedford, Mass.

The Arcas research rockets, made by Allstate Research Corp., Alhambra, Va., are carrying small telescoped Mylar plastic balloons, manufactured by C. T. Schepelink, Northfield, Mass., called Kalsa (Kalsa Balloon Instrument) (AW Oct 17, p. 67). At the peak of the rocket's trajectory the nose cone is separated and the balloons inflate. The balloons, which carry millipede radar reflection retrodies, descend rapidly from peak altitudes at approximately 180 ft., slowing gradually as it comes down to and at 100,000 ft. releases from the atmosphere's increased pressure.

Ground radar plot its course during descent to determine wind direction, atmospheric density and temperature.

**Great games—that made scientific filtration possible!**



**Pascal's laws:  $\frac{P}{A} = \frac{P}{A}$**

\*Pascal's law is a scientific principle that has been demonstrated throughout the history of the continuing world.

Blaise Pascal (1632-1662)

Although Pascal's Law is more than 300 years old, it is still one of the basic principles that must be taken into consideration in the design of new products for modern industry. And Air-Maze engineers, in their specialized field of developing better methods of filtering liquids and gases, are even conscious of the importance of Pascal's discoveries.

For 35 years, whatever the filtration requirements—hydraulic presses or jet aircraft, air compressors or vacuum pumps—Air-Maze has been at work keeping equipment running better and longer by keeping it clean and free from damaging contaminants.

The products shown below are representative of the many designed and developed by Air-Maze engineers to meet special filtration requirements. If your product involves any gas or liquid that moves, Air-Maze can help you.



**High-pressure liquid filter usually used as jet engine and aircraft.**



**Open direct filters, either disc or pleated type, for filtration in any available condition. All used in various media for high efficiency work at elevated temperatures. Available with or without housings.**

**GENERAL AIR-MAZE PRODUCTS:**

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## Performance of This New Accelerometer Is Spectacular!

And CEC's Type 4-202 Strain Gage Accelerometer is also the smallest on the market...measuring just one cubic inch.

Here are some of the performance characteristics that make the 4-202 infinitely superior to any other linear unbonded strain gage bi-directional accelerometer:

Its cross axis response is unusually low...its resonant frequency is unusually high...and there's extremely little damping change over a temperature range of  $-65^{\circ}\text{F}$  to  $+250^{\circ}\text{F}$ .

The 4-202 is the smallest temperature compensated instrument you'll find anywhere for measuring accelerations perpendicular to mounting surfaces. It's available now in a range of  $\pm 5g$  to  $\pm 500g$ .

For more information, write for Bulletin CEC 4202-X4.

Transducer Division **CEC**

CONSOLIDATED ELECTRODYNAMICS / pasadena, california

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all will be lost. However, there are others who believe that to be an overstatement of the case. There is no doubt about the military requirements for accurate, long-range ballistic solutions and for measurement and control systems that can detect the subtlest shifts and more than that! The present demands at high levels but there are no really delicate sensors. Whether the ultimate goal, the program is going to be very expensive. What is going to make the weapons and control systems about the program? The considerations will involve much more than technology.

### Scientific Enthusiasm

The physicists and other scientists who are enthusiastic about space control that no expenditure of money or effort is too great if it leads to a better understanding of our physical universe. The engineers, also, because of the intricate and complex gadgetry are automatically involved in all these programs are made related with the same view of enthusiasm.

On the other hand, some earth-bound scientists are viewing the trend with considerable alarm, perhaps brought such fiscal gaudiness, biological and medical research control that an additional 1000 million expenditure in that field (about the cost of one modern space exploration) might very well produce the breakthrough which could lead to the understanding of the cause and the discovery of cure for cancer. The investigation of high energy plasma for more and more apparatus. They are not thinking of outer planets. The proposed two-mile-long accelerator at Stanford will call for an initial investment of at least \$125 million.

Some astronomers are lamenting a relatively recent! They contend that the depths of the ocean are far more important than the depths of space and that our ignorance of the important facts about the Solar System is truly shameful. A number of new astrographic records reveals at a few inches below space are called for, immediately. The geologists want to go under water, too. The "Mobi" project which will involve drilling into and sampling the outer-most layer of the earth's disk, under about 10,000 ft of water, is most intriguing. Undoubtedly the information obtained would be very important and it might be getting for a billion years of about 150 million.

While military necessity and the scientific urge are compelling motives, they are always backed up by an insatiable desire for international peace. Our delicate glass arms to take the shape of a shadow that looks curiously like the Russian bear. Even so, there is a tendency among some scientists to postpose the importance of the pro-

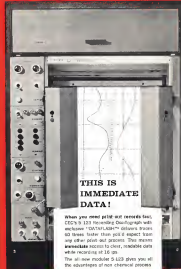
ject factor. They say it is unbecoming of a scientist to have anything to do with, or give any consideration to, international propaganda. However, such they can hardly ignore their bodies which give evidence of constant employment in America because Russia occasionally manages another technological coup. Our national standing is very much at stake and that is a most powerful motivating factor in our national program.

While the scientists and engineers lobby for position and government support in the physical fields, the college and university professors stand in the wide lanes (along with their professors) and swing their hands. "You are talking us out of our faculty" they cry. They are not entirely consistent because many of these institutions are heavily involved in extensive research in these important projects. Yet there is no denying the fact that the competition of these sciences, project gaudiness and, in some cases, patriotism, is clouding the faculty's eyes in equity as well as equity, yet at a time when unprecedented demands are being done on institutions of higher learning.

It is quite evident that there is not even enough human talent (and probably not enough financial resources) to do all the wonderful things which America seems to be demanding of itself. Patrons and programs seem to evolve at random or are assumed at by default. It may be contended some great and few decisions must be made and taken so as to be the subjects of an occasional disaster, also it is made there. Such decisions in our complex world involve nations which are for the most part beyond the ken of legislators, government executives or the usual variety of human beings.

### National Decision-Making

Perhaps they are not aware of it, but the scientists and engineers are playing an increasingly important role in national decision-making. In their past as employees of government agencies, in the military services, as members of advisory bodies, they frequently are in a prime position for making value judgments about those very expensive and important national programs. The creation of the position of Special Assistant to the President for Science and Technology and the scientific studies at the subnational level is further evidence of the impact which scientists and technologists have in passing judgment on non-political matters. The criteria for making such judgments are not to be found in any textbook, nor are they clearly delineated in any available statements of national policy. The role of the scientist and engineer in our national well-being is far more complicated than it was in the



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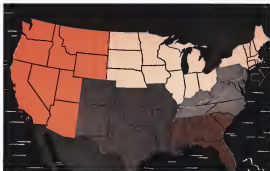
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## Target Missile Sets Altitude Record

RP-75 rocket-powered missile recently established a new target missile altitude of 71,900 ft. at White Sands Missile Range, N. M. Manufactured by Raytheon Division, Burlington Corp., the missile climbed a speed of Mach 1.85 during flight.

good old days of a generation ago. Although these major national efforts have been large, they by no means encompass the whole picture of our technological life. It might be revealing to review some other areas of technology, which are of great interest to the public, which are not considered in the traditional aerospace curriculum.

### Bridge Design

One of the outstanding structures in our country is the George Washington Bridge which spans the Hudson River (172nd St. in New York City to the Jersey Shore). In the original design the two supporting end columns of this great suspension bridge were to be connected with members in keeping with tradition. This was justified on the economic grounds of protection of the steel structure from the weather. These members were to be the subject of a great deal of debate and finally, after considerable argument, the design was changed, eliminating the members and leaving the steel towers with their open, lattice structure exposed to the weather, even though the economic argument against such a change.

The decision was made on the assumption that open towers would be much more beautiful than ones which were covered with a layer of weather steel. Here was a case where the decision was made on the basis of aesthetics, rather than the usual engineering criteria for economy.

One of the most debatable and debated projects of the New Deal days of the 1930's was the Tennessee Valley

development involving power dams, flood control and the introduction of new industries. The arguments, pro and con, ranged from the very humanistic theme of the enhancement to the cause of "economic knowledge" of the conservation. The project did proceed, of course with extensive federal support, but the decision was not made on a strictly economic or engineering basis. Essentially they were made with an eye to the sociological vision as well, even though some of the critics said it was a costly government policy.

Now, after some twenty-five years, the Tennessee Valley Authority has been accepted as a part of American life and there is no question that it has greatly benefited the economic and social well-being of that extensive region. It is not possible to set up a hypothetical balance sheet to determine whether or not it has been "profitable" in the purely business sense. Probably no such a determination can ever be made. The point is that sociological factors, other than technology and simple profit or loss, have in the past and probably will in the future play more and more into the major decisions in valuing certain engineering projects.

The nationwide and decade-long program under the aegis of the Rural Electrification Administration, which began in the same New Deal days, was subject to the same debate and criticism as the Tennessee Valley project. This program involved the federal support of a widespread rural network of electrical utilities which individual power companies, either privately or

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can to fully owned, could not pitfall as the loss of unimpaired revenue. The debates on this subject were quite lively with many occurrences of political deadlock and passage of federal funds like again, however, the pattern of real estate funds, is now quickly accepted and the various power companies which supply the energy are glad to have the business. It is true that the initial capital investment for the widely scattered customers could not have been paid to shareholders or to municipal governments.

## Economic Goals

There is but little debate, however about the technological as well as the economic goals that have resulted for the real customers. Since 97% of real America has now been electrified. More than 1,000 locally owned—mostly cooperatives—have paid some \$1 billion in principal and interest on the \$54 billion REA loans. That is not a very good return on 25 years from a strictly business point of view but when judged by the criteria of national economic and human welfare it may well be. Vice versa would want to go back to the old leverage buy-out hand pump drive, particularly if they happen to be rural residents. That, again, was a pattern of rapid decisions based on an over-sold technology rather than on an infrastructure base.

We may have come to a very different type of problem—one which looks to the future. The 1968 census reveals some very significant trends in American metropolitan centers. The core communities (downtowns) are steadily

losing residents and the suburbs beyond the city limits are growing, faster or less expensively. This is due, of course, to the increased availability of automobiles. The dimensions of income cities were largely determined by the inside working distance. The early American city pattern developed around the horse-drawn vehicle, supplemented later by electric public transportation. So the boundary lines of the city spread but the pattern concentration of residents tended to remain near the center. Now, however, the apparently insatiable desire of parents to give the children breathing space and green space, plus the opportunity for independence exemplified by driving the private automobile has led to the exodus from the downtown area.

But at the same time, whether it be from light or habit, a large proportion of the business affairs remain concentrated in the central portion of the cities which the thousands have been abandoning in a place of residence. That leads to the serious danger of urban congestion of growing to such levels that with its attendant friction, lost time and inefficiency and struggle for parking space. Further, as the former residents migrate to the suburbs they tend to be replaced in the core with commerce and nonproductive industries, the old-time tax structure is broken, the capitalization of fragmented governmental organizations becomes obsolete. Does it really make sense? The question becomes more pertinent by the week.

Oh, perhaps a commentary the case of New York City is too small a unit. The metropolitan which now extends from



## INTERNATIONAL MISSILE AND SPACECRAFT GUIDE

Start 1968. Addressed to: Space Agency and International Air Transport Association. This guide provides information on missiles, rockets, spacecraft, and space stations. It includes details on the design, development, and testing of these vehicles. The guide is available in English, French, and German. It is published by the International Space Station and the International Space Station.

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## Regulus Missile Launched as Target Drone

Rocket motor launching Navy Chance Vought KDRU-1 Regulus missile in a Markulyn N104 solid-propellant booster developing 130,000 lb thrust. This was the second successful launch of Regulus in a target drone. Regulus was launched by Navy in 1955 (AW Dec 19, 1958, p. 27).



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Review down the East Coast to Washington captures an unprecedented ecological complex. In view of most our contemporaries and more nations, should there be only a few concentrated water of human and natural, is there the many activities be spread out in such smaller units? There is a long way to go before we can begin to plan for the future, as far as I know, have been made completely in health and safety. What are the in question also will question such studies? It has concluded that adequate talent is available if it were properly trained. I am questioning the author's claim that this because while it is plain from such studies come to a point of division economic, ecological and logistic factors will certainly come to a point of division. However, the division which must be made will be completely engineering in character if we accept the definition of engineering as the solution of problems of improved design.

In the view to come a great many American engineers may well be put out of their activities beyond the physical boundaries. If this country is to maintain its leadership in Western civilization, a substantial proportion of our technological skill will have to come from the boundaries and will become involved in the international arena. Our technological nature naturally spreads to other shores. I am speaking of more than the present foreign investment of American business, military operations and foreign aid. Our technological skill will have to spread the gates.

Within the next half-century the world population will undoubtedly ex-

ceed from the present two and three-quarter billion to five or six billion. From whence will come all the natural resources—timber, food, minerals, energy, metals and water—to provide the physical framework for a reasonable, acceptable, standard of living for these many billions of people? It is obvious that we, as a world, are going to have to learn to get along and even from less and less in order to meet the basic life demands. This is going to call for a great deal more basic research knowledge than we have at present and large amounts of engineering ingenuity. The expenditures for the necessary research program can hardly be justified by individual private industrial organizations for the simple reason that financial gains will be a long time in coming, if any. Yet if the nations of Western civilization, particularly America, do not undertake such studies, the consequences are undoubtedly self-inflicted and they will see the grip of technological progress to capture the environmental studies of the world.

What research and engineering developments should nations undertake to help solve the problems of the continuing rapid of a world resources for itself and the rest of the world? Who should even then act and how should they be financed? These questions approach points of critical decision. If they can be solved, the engineers will certainly have to play a primary role. It will necessarily have a major part in determining and maintaining at the points of application of feasible developments.

In doing these examples I have touched on matters which obviously in-



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Aircraft Associates, Inc., Goddardsville, Md., engaged in applied research and development in the fields of aero-

dynamic, ballistics, electronics, and space, and electro-mechanics and in the design and manufacture of electronic, electrical and mechanical devices largely for the Department of Defense. Offering is 275,000 outstanding shares of common stock. These shares are to be offered by United Industrial Corp., a Delaware corporation, to its stockholders of record as Nov. 15, 1959, for subscription at the rate of one share of Aircraft Associates stock for each eight shares of United Industrial common stock held, subscription price and underwriting fees to be supplied by underwriter. Purpose of the offering is to provide United Industrial with additional funds for general corporate purposes and, together with the distribution of 85,100 shares of the company's common stock to common stockholders of United Industrial as Nov. 16, 1960, to "revitalize the market" for the company's stock. United Industrial has no current intention of disposing of any of the other 343,908 shares of Aircraft Associates' stock owned by it.

## Stock Transactions

The Securities and Exchange Commission's Summary of Security Transactions and Resultant Holdings for the period July 11 to Aug. 10, 1960, reported the following transactions by three executives of Muscardin Corp., acquisition of 200 capital shares by William Lefkowitz, director, making a holding of 100, disposition of 200 capital shares by William H. Schwab, officer and director, leaving a holding of 616, disposition of 200 capital shares by Harper Woodford, director, leaving a holding of 5,600.

Other transactions for the period July 11 to Aug. 10 included:

**Albany Aircraft, Inc.** Acquisition of 1,000 common shares by Benjamin D. Rabin, director, leaving a holding of 1,000.

**Anacostia Research Corp.** Acquisition of 245 common shares by Scott E. Schmitt, officer and director, leaving a holding of 1,000, acquisition of 1,000 common shares by Franklin C. Sweeney, officer and director, leaving a holding of 1,000, disposition of the common shares by Dr. R. E. Sweeney, officer, leaving a holding of 1,000.

**Arco Corp.** Disposition of 5,000 common shares by James F. Ross, officer and director, leaving a holding of 200,000, acquisition of 1,000 common shares by Dr. J. A. Macpherson, director, leaving a holding of 1,000, disposition of 1,000 common shares by Dr. R. A. Macpherson, officer and director, leaving a holding of 1,000.

**British International Corp.** Disposition of 1,000 common shares (representing 100 shares) by Barry D. Brown, officer and director, leaving a holding of 100,000.

**British Airways, Inc.** Acquisition of 4,000 common shares by William A. Hocking, director, making a holding of 223,100, disposition of 1,000 common shares by the total holding by Alan Hocking, director.

**Comma Airways, Inc.** Acquisition of 4,000 common shares by Frank A. Bortugno, director,



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## BUSINESS FLYING



PIPER CHEROKEE is replacement for the Tri-Pacer and will cater production at Vero Beach, Fla., only in 1980.

## Piper Widens Lower-Priced Airplane Line

By Herbert J. Coleman

Grand Bahamas Island—Piper Aircraft Corp. has designed two new airplanes to replace a greater share of the low-cost airplane market while still pursuing wider sales of its "hot" line—the Cherokee, Arrow and Apache.

The new airplanes are the forerunners of an increasing emphasis on research and development at Piper which, executives promised, will result in a

new model every year. The planes are: • Golf four-place sport and business plane which will sell for \$4,995 and is largely derived from the lightweight Tri-Pacer (AWC Oct. 11, p. 14).

• Cherokee, a four-place low-wing aircraft designed to replace the Tri-Pacer and which will sell for \$3,995. It received Federal Aviation Agency approval during Piper's international distributor meeting at the Grand Bahamas Club.

The Cherokee, like the Piper Apache

apartment plane, was developed at Piper's new Vero Beach, Fla., production facility, where it will be built early next year on a five-sided basis to start. The Colt will be manufactured at Piper's main plant at Lock Haven, Pa., and, according to William T. Piper, president, "it will be the first of the high wings" referring to future development.

The manufacturing of about 500 planes attending the company's most amazing firm in far away New Zealand, copied a report by J. W. Miller, general sales manager, that Piper is aiming at a second sale in 1981 with sales rising at a \$62,500,000 total cost.

### Domestic Sales

Part of this sale comes from increased sales efforts overseas, according to Wolfe Seabach, export sales manager. In 1981, exports have accounted for 56 million worth of business, he said, and Piper hopes to appreciably expand that figure next year.

Sales this year, Miller pointed out, will reach about \$31,500,000 "and it looks like the best year ever, despite a recession this summer." Sales in 1979 were \$44 million.

Total unit sales in 1980 are 2,583 airplanes, Miller said. He claimed that Piper captured 15% of the recreational market with its Arrow and Apache

30% of the high performance single-engine market with the Cherokee 180 and 290, 74% of the special purpose market with the Super Cub and Pioneer agricultural airplane and 12% of the touring, utility and sports plane market with the Tri-Pacer and the Colt four.

Tri-Pacer sales toward the anticipated 1980 figure, Piper division will sell the Colt as an introductory model business—\$995 down and payments of \$29.65 a week. Contracts will be made through Commercial Credit of Maryland, Inc., and Piper expects the same rate. But plans of credit purchasing to establish standard Colt volume.

Meanwhile, Piper is looking for the Colt to introduce a sport and student flying aircraft that has been in the 1970s. The Colt's low wing, plus a dual to sell the plane to flying clubs on a "Lease to Fly the Colt Way" campaign is expected to accomplish this.

### Business Application

Piper also will push the Colt as a business plane for operators of small firms who rent the plane for comparatively compressed outlay—up 100 miles from their operations.

As Willy Miller, assistant general manager of sales, put it:

"The Colt will be within the financial reach of small students. They will be buying built today. We want to

sell the Colt to every airport agency that can use it, stressing its sport and recreational capabilities."

In the meantime, the Cherokee will move into a field established by the Tri-Pacer, whose sales picture has been declining from 1,149 planes sold in 1976, to 994 in the first year.

"The Colt will be the mid-business airplane," Miller stated. "Then we'll move the base with the Cherokee and the Cherokee, going at three single-engine planes to work with."

Eventually, Miller said, Piper hopes to develop a stable of 718 Colt derivatives and will do so, with the so-called A, B & C line derivatives, attacking the plane issue to the corporate market. He said the company hopes to be able to increase combined deliveries (single and twin engines) to 194 from the present 180.

"We want to increase and expand the dealer group in order to grow," Miller stressed. "We can make our own history with the new planes in terms of basic costs, lower purchase and resale."

Need for dealer segmentation is evident from new history Miller contacted. In 1970, Piper had 2,000 dealers and their total sale 1,300 airplanes for a \$4 million retail gross. By joining the same-selling into conventional key locations, business and management, inter-

connecting ability, the Piper facility settled on 365 dealers.

Piper also is branching into the aviation field and has established an Elmwood Division at Vero Beach which is, mostly, in building its new low-cost Apache, Arrow and Apache and Boeing device on a five-sided schedule.

### Temporary Housing

The division is housed in temporary quarters and unit production will be increased when new quarters are completed. The Arrow will be \$595, roughly \$1.10 or and a second in the Colt and Cherokee also of airplane. Piper's Arrow to become pilot is built at Lock Haven and has been an important sales factor, according to Edward "Bud" Piper, vice president in charge of research and development. It costs \$1,995 installed (the down is \$750 for the aircraft control, \$750 for pitch control and the balance for struts control).

Piper now is developing a true, narrow fuselage and easy mount into the VHF field in the future although Howard Piper observed that "we are not competing with Cessna and Mooney in the higher priced field."

The Vero Beach operation, where the Cherokee will be built, was obtained by Piper from the City of Vero Beach on a 99-year lease; the company now is negotiating for an additional 95



TWO-PLACE Colt 165 is Piper's entry in the sport and student flying field. Plane with the \$4,995 is standard model.

## Small Airport Expansion

Grand Bahamas Island—Grand aviation must look for future expansion to the small cities and the airports they can provide, William T. Piper, president of Piper Aircraft Corp., said here.

He predicted that the day of the small, unoperated airport will be a necessity to ensure the safe use of the lightplane. With some full bridge available, the lightplane no longer needs the airport merely as a fuel stop, but can use it as both business and pleasure in a wide area of flight.

Piper pointed out that "in urban get bigger and the airports become faster, the steps get lower and coming airports get more complex." Small city airports need not be expensive grass strips will suffice, he said, and even some an efficient for development. He also pointed for community ownership, instead of private ownership.

Piper himself the 1st Annual International Distributor Meeting at the Grand Bahamas Club, concluding it as the first of its kind held on foreign soil. Overseas distribution attending were Charles Berrin, New Zealand; P. G. Marquis, Australia; T. A. Vignos, England; the Marquis of Kintyre, Ireland; E. A. Cameron, France; Peter Van der Meer, South Africa; and John Kerr, Switzerland. Next year's meeting probably will be held at the new Vero Beach, Fla., production plant.

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CHEROKEE lightplane has Piper's snapback tail, resembles high-performance Cessna's.



THE CONCEPT of wing can be seen in this view. Piper has not yet revealed exact specifications.

seems to add to the present 20-acre site. Mass building is expandable to the north, with one supported by their salesmen and can be moved southward to extend road and floor areas. Plant is headed by Luther Blum, former director of purchasing at Lockheed. Cherokee will be built in a 120,000 sq. ft. factory area still in the process of completion; first two prototypes, however, were built there, although new tooling and jigs are still being installed. Plans will follow a U.S. patent pending at the point shop which will include hydraulic hoists to position the planes for faster painting. Rollout is made directly onto the runway on the main ramp. In looking to the future, Blum says Piper was built in his program. "We can develop planes faster than production or sales can handle them."

### Cherokee Design

The Cherokee will be considered as Piper's new model for 1991, although its release since this year, two years after the pushback and what Piper called a "solidified risk" to build the Vero Beach plant.

Key objective was simple to replace the Tri-Pacer and move into the four-seat, low-cost, low-risk field, made was the Cherokee, which resembles the Cessna. The price, according to Blum, is "very close to what

the Piper would have been in 1961, if we had continued it."

The Cherokee is of all-metal construction (Piper was later a bulk that depended on the Cessna) and empowers was placed on don't flight characteristics. The plane was not available for flight evaluation at the opening, since it still carried the experimental tag, but this decision is evident by wide spread gas and quite thick wing.

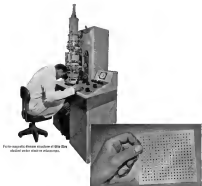
Plans will cruise to come at 170 mph. Powerplant is a 160-hp O-318 160-hp four-cylinder carburetor engine. Standard fuel capacity is 16 gal. with additional capacity available to increase capacity to 50 gal. Fuel tanks are an integral part of the wing.

The Cherokee has a gross weight of 2,300 lb. and an empty weight of 1,185 lb., giving a useful load of 1,015 lb. This was a major design objective—size the Tri-Pacer weight was, but with 1,000-lb. plus payload. Fuel consumption will be about 9 gph.

Labor costs are cut because of design simplicity: wide use of aluminum, which is less expensive than steel, fabric and tubing, and a carburetor in parts, since the Cherokee has 1,200 parts, compared with 1,600 for the Tri-Pacer.

Cherokee has a large baggage compartment with a separate outside door for easy access.

Production will start in January and



Piper's design shows structure of the line studied under electron microscope.



Scanning electron study produced by deposition of metal-oxide layer.

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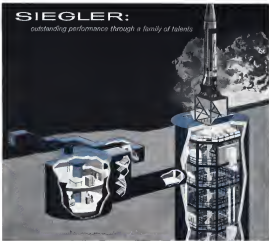


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**COMBINED** Dornier Do. 27 and Do. 28 production line at Dornier Werke GmbH plant near Munich. Current production of about 35 airplanes per month probably will be boosted to 7-10 planes as Dornier looks up to produce landing gear system of the Fiat G.91 tactical fighter being built under license for West Germany at least by a contract of firm for 7901 rollout.

## Dornier Eyes U.S. Market for Do. 27, 28

By Cecil Browder

Munich-West Germany's pioneering aviation industry may soon branch a short season into territory long considered the province of U.S. high-speed manufacturers, making a major bid for sales of the Sieglar Do. 27 and its two-engine counterpart, the Do. 28, to the North American continent.

Major deliveries for such a new-expected line within the next two to three months will be final Federal Aviation Agency certification of both aircraft on a concurrent basis. British certification is expected at about the same time, and a company says these markets are also important.

The single-engine Do. 27 already has been sold to a total of 10 countries stretching as far from Rome as New Guinea. Within the Americas, a Do. 27 has been sold in Brazil, and a Do. 28 is now demonstrating its short field characteristics on a tour of South America in hopes of boosting Dornier's sales there. FAA certification will open the door to the north.

Primary sales effort within North America probably will be directed toward the potential of the Do. 27 and 28 in bush planes capable of operating into the unimproved fields of Midwestern farm plots or from forest-surrounded clearings of the northern woods.

Dornier officials believe the Do. 27 has proved its rugged character, including a minimum of maintenance needs, with the West German air force and

private operators, and is moving to obtain a similar reputation for the Do. 28. Aside from the South American tour, a Do. 28 recently completed a 15,000-mi. tour through Africa, including 300 landings and takeoffs from fields ranging from good commercial strips to corrugated and jungle drainage. The aircraft, according to Dornier, performed "above all expectations" and required "no problems" and began and completed the trip "on schedule."

The price also should be a competitive factor. The export price quoted

here for a standard version of the latest version of the Do. 27, the G5 powered by a 270 hp. Leosang G51-460-B146 engine, is \$17,000 DML or slightly more than \$25,000. Export price for the Do. 28 powered by two 250 hp. Leosang G51-410-B146 engines is quoted at \$19,000 DML, approximately \$27,000.

When last, Dornier has rolled off a total of 500 Do. 27s—420 of them for the West German air force as air trainers and reconnaissance aircraft—and 10 Do. 28s. It is currently producing at the combined rate of about 10 planes per



**SHORT** takeoff capability is demonstrated here by the Dornier Do. 28 two-engine plane.

# BEECH "IMAGINUTY" IN Cryogenics

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Beech "space flights" at Boulder, Colorado . . .

## Pioneering in testing of space vehicle components ...including liquid hydrogen fuel tankage systems

Big things are happening at Boulder. Here, now, the Bureau of Standards cryogenic engineering laboratory, Beech has assembled a highly competent team of scientists, engineers and technicians, chosen for a combination of skills, experience and interests. Working with the most modern equipment (much of it Beech-developed), this team is performing vital roles in per-

fecting advanced propulsion systems and components. Beech qualifications for future assignments include more than 6 years experience in liquid hydrogen propellants and liquid hydrogen storage; research, development and fabrication of aluminum tankage systems; and environmental testing of a wide range of missile components and systems to qualification.

**Beech Aerospace Division**

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months. First delivery of the Do. 28 was recently made to a West German air force operator.

Production lines, however, are now being shifted to make way for Dornier's dual air Germany's forward production of Italy's Fiat G-91 lightweight fighter fighters and, unless manufacturing-related aviation orders are received, production probably will further cut in a combined rate of between 7 and 10 aircraft per month.

Dornier will produce the cockpit section of the G-91 fuselage and be responsible for final assembly and flight test at its Oberpfaffenhofen Airport near Munich, where the Do. 27 and 28 have been put through three initial phases.

Consequently, Dornier is offering the Do. 27 and 28 in workmanship capable of effectively carrying out a wide range of data-capture, checkout, visual review and photography, which the Do. 27 is now doing for Sparrow, ambulance and rescue work, which the Do. 28 is conducting for the West German air force's light twin, short-field traffic and border service.

### Operationally Similar

In addition, the similarity between the short takeoff and landing and flight characteristics of both aircraft provide them with a wide sales potential and, operationally, the two are remarkably similar even for length, with the single-engine Do. 27 sometimes outstripping its successor.

The lightweight Do. 27, for example, has a stall speed of 1,060 ft/s, as compared with 1,120 ft/s for the Do. 28. It has a range of 995 stat. mi. without reserves at sea level and 80% power at 4,000 ft. altitude as compared with 660 stat. mi. for the Do. 28 under the same conditions. Its endurance at 45% power is 9 hr., that of the Do. 28, 5.45 hr. The Do. 28, for its part, has higher ceiling, cruising speed and rate of climb, and at the higher gross weights of each aircraft, shorter takeoff capabilities plus the effectiveness of the added weight of safety a second engine can provide.

### Performance Data

Comparative performance figures for the two aircraft include:

- Fuel capacity—Do. 27, 46 U.S. gal.; Do. 28, 111 U.S. gal.
- Wing span—Do. 27, 39.4 ft.; Do. 28, 46.4 ft. Additional Do. 28 span is due primarily to the extension of an additional fuel tank in the fuselage of this wing structure above the fuselage.
- Length—Do. 27, 33.3 ft.; Do. 28, 29.6 ft.
- Empty weight—Do. 27, 2,490 lb.; Do. 28, 3,618 lb.
- Cruising speed at 75% power at 6,000 ft.—Do. 27, 340 mph.; Do. 28, 361 mph.
- Maximum speed at sea level—Do. 27,



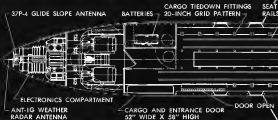
COOP during configuration of Do. 27 has been out along behind the leading gear.



FIXED as a solid undercarriage, the Do. 27 has been sold to West German air force.



SES attached to the main landing gear has been added to this Do. 27 for bank work.



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bring mission support operations up to date—and save millions too. The JetStar's high cruise speed and long range (Mach 0.814, 2,000 nautical miles) give it a much higher rate of substitution than the average support aircraft now in service. The JetStar's pressurized cargo compartment provides flexible arrangements to transport 14 people, priority cargo, or specialized equipment. It has been mathematically demonstrated that the modernization of mission support fleets—placing in JetStars to replace obsolete airplanes—can save the government millions of dollars.

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### Mid Continent Opens Colorado Facility

Mid Continent American Corp. opened new facilities at Jefferson County Airport 11 mi. northwest of Denver, Colo., as part of export defense expansion. Facility includes 33,000 sq. ft. hangar and 87 hangars. H. A. Smith is president and J. M. Scales is branch manager. New airport has a 6,600 ft. runway, manager is George DeVore.

152 mph, Do 28, mid at 871 mph.  
 • Mach speed at sea level: 445 ft. Do 27, 31 mph; Do 28, 34 mph.

• Approximate service ceiling—Do 27, 15,600 ft.; Do 28, 20,900 ft.  
 • Rate of climb—Do 27 at 3,970 ft. gross weight, 3,800 ft. in 6 min; Do 28 at 5,190 ft. gross weight, 3,000 ft. in 2.4 min.

For a takeoff run, the Do 27 requires 810 ft. of roll and 919 ft. to clear a 50-ft. obstacle at sea level at 4,380 lb. gross weight, while the Do 28, at 5,190 lb. gross weight, needs only 568 ft. and 760 ft. respectively.

At lower gross weights, however, the Do 27 moves into the lead.

With an 8 ft. wind and a lower gross weight of 3,100 lb., the Do 27 can become airborne after a 10-ft. roll, clear a 50-ft. obstacle within 400 ft. The Do 28 with an 8 ft. wind but retaining its 5,110 lb. gross weight needs a roll of 440 ft., a total of 700 ft. to clear a 50-ft. obstacle.

Loading at a gross weight of 1,750 lb. and sea level, the Do 27 can come to a stop within 181 ft. The Do 28 at 4,700 lb. gross weight, requires 155 ft. of runway under the same wind base.

The prototype of a potential successor—the Do 28—can take off in sea level conditions after a 11-ft. roll, clear 50 ft. and come to a halt after landing under the same conditions between 80 and 93 ft. from the end of the runway.

The Do 29 prototype is a tail-surface pusher design in which the propellers are revolved downward to provide lift during takeoff. A single shaft

working from one gear box rotates around the possibility that a malfunction could throw the aircraft off course by moving one propeller downward while the other remained stationary facing aft.

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Republic Star Trek II modification has enlarged cabin and costs about \$125,000. Pilot can seat up to 16 passengers, ceiling has been raised 11.5 in. Nose has been lengthened 5 ft. to accommodate the new gear. Republic is installing existing Boeing 520 turbo-prop engines and new Lycoming 720 eight-cylinder engines on Star Trek II.

## Design Details of Three Modified Executive Twins



Volga modification of a Beech 18 converted C-191 is confined to addition of tricycle landing gear which will be available in 60 days. Modification will increase gross weight less than 210 lb. Gear is electrically actuated and all wheels are covered by doors.



Sikorski S-12 light twin, five place, design is derived from a former Monocoupe Club project. Powerplants are two 150 hp. Lycoming O-360 A1As having Whetzel popovers. Gross weight is 3,500 lb. and plane cruises at 199 mph. at 7500' power range at 1,200 rpm. on 320 gal. of fuel. Available Flapkins is used extensively on nose section and vertical fin.



Nose gear on Volga Beech 18 modification (left) is tied to two door levers to transmit loads to the monocoupe structure. Standard nose gear in Volga design is not desirable although this former can be provided as optional equipment. New gear is counterbalanced and retractable. Side doors have less clearance than standard landing gear. At center of nose gear on the Republic Star, which is tied to two main fairings levers. Side doors for closing doors, gear retractors extend and is retractable 10 deg. on either side. Side gear on the Volga Beech (right) is tied to a door linked to the second cabin gear, plus additional members fitted in the center wing to take care of added forward loads. All three wheels retract at 5 sec. Note how the gear door is repped to provide a cover for the wind.



Instrument panel mounted in the Sikorski S-12 has dual controls, centered throttle and propeller controls. Yoke panel also is centered. Engine gauges are placed on a sloping panel below the main panel. Panels were modified by Sikorski Aircraft & Engineering, Oxford, Calif.; Volga, Inc., Pomona, Calif.; and Kunk Engineering Ltd., San Francisco, Calif.





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broken, and the cylinder starts were fixed. The engine's new master rod and connecting rod could not be saved.

The front row master rod link rods were in several conditions. There was evidence of the master rod link rod upper portion of the engine and the auxiliary cylinder below these rods. The left engine's cooling fan, both main and accessory rotors, was damaged by the failure of the engine and by impact with the ground. Seven small round rubber magnets and six cooling supports were found on the runway. The fan was found only 1,000 ft. from the tailfin and a rectangular rubber engine box pul which matched the cool fan was part of the No. 1 cylinder position. Seven feathers, a cooling tank, a 100 lb. section of the heater case and a section of a cool fan were found on the runway. The engine cooling system was the most seriously damaged. This system has evidence of serious heat and some burning. A section of the top of the cool fan was seen in a way for the cylinder attached was bent upward and increased at an angle over the bottom left corner. The entire accessory section of the cool fan was distorted somewhat with feathers torn out in some pattern and holes in others. The propeller governor and balancing parts were checked and found capable of normal operation.

### Impact Forces

The right engine also appeared damaged. The right engine had impact forces that were found next to the propeller. This engine suffered impact damage and was found that prior to impact it was functioning in a normal manner.

The left propeller was found detached from its engine. The blades were bent and damaged by impact forces, the dome was not damaged. It was determined that all three blades of the propeller were positioned at a blade angle of 75 deg. at the time of impact. To be fully feathered the blade angle should have been 85 deg. The right propeller was also found detached from its engine. The dome and blades were damaged by impact forces. The blade angle was determined to be 75 or 80 deg. These blade angles indicate that the engine was developing power at the time of impact.

As could be expected, the aircraft was both damaged by impact and the subsequent crash-landed. None of the damage to the aircraft constituted an any way to the cause of the accident and therefore will not be described. It was determined that the CO's fire extinguisher bottle had not been used. The landing gear and legs were found in the up position.

### Aircraft Maintenance

Pacific Air Lines performed all major overhauls and all major inspections of its aircraft and components, with the exception of propellers, at the company's San Francisco base. The overhaul of propellers was done by an outside agency. At Los Angeles the company contracted with International Flight Service, a local company, to run and test all aircraft, to perform maintenance and daily inspections if needed, and to make all necessary repairs.

Company dispatching for the route was solved via teleconference from San Francisco.

Records of aircraft and engine, basic, etc., were kept by the maintenance department and when it was time for an aircraft to return to San Francisco for major inspection or repair, complete flight records were allowed and the aircraft was completely scheduled to return to the airport and if necessary another air was sent to its place. N 6759 had been given a 1,270 lb. inspection 15 or 20 hr. prior to the accident.

N 6759 was based at Los Angeles and therefore was under the supervision of International Flight Service with respect to maintenance.

### Previous Checks Made

The left engine of the aircraft had a number of oil leak complaints which were entered on the flight record for several days. These began after 75 and continued through Oct. 15. Each day was entered in a mechanic and an explanation given explaining the situation. When the Canadian airline scheduled the replacement of motor oils and pistons, motor bearings, and the tightening of hold-down nuts around the propeller governor. On Oct. 15, 1979, an oil leak was in the log was left left engine. The explanation of the mechanic was written as follows: "Checked for oil leaked down left engine and replaced gasket and motor fan gasket." These items were installed by the mechanic during the work and according to International Flight Service the aircraft at each airport was considered to be, correctly.

On Oct. 15, 1979, Mr. Glen Smith, the owner of International Flight Service, had



### Quick Engine Change Facility for B-52H

Test stand providing quick engine change capability for B-52H Air Command units getting the new B-52H has been developed by Bendix Division at Boeing Aerospace Co., as the airplane's Port A-1 Whistler Aircraft 10-11 turbine engine. Stand under parallel to the engine testing of the complete TF33 power package, including accessories, so that it can be installed quickly after check, to replace a failed propeller. Specially designed stand takes into account the turbine's intricate flow duct, which provides a torque requiring special fittings on the stand to restrain the engine during ramps. Air Force and air-line officials from major USAF commands recently inspected the new stand during a demonstration at Boeing Wichita.



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WORK IN THE CLIMATE OF ADVANCEMENT

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the following teletype message sent to the company's San Francisco office, "Martin believes that they [the] jet was not on the 101/DTX as either it got off back to SFO the day of the left engine which we have been unable to stop 6/26/59/101/ 124/ 125212.

At 1212, Oct. 26, 1959, the following message was received from Pacific Air Lines flight control: "7-135/59. This 101 on its 101 X 113/7248." According to, they 101 was scheduled to descend.

Mr. Bond testified that his operations had done everything it could to find and stop the jet before the last minutes of their contact. He said that the night before the flight was scheduled the engine was removed from the plane because it was found to be defective. The engine was then left overnight in order to be able to run any day which may have been during the night. Some was found the first morning and the engine was then not used it was not to be used if night took under the conditions. Again no look was found and accordingly the engine was not used and the aircraft made only for flight. Mr. Bond further said that he considered the engine to be suitable.

Maintenance facilities of the company at San Francisco were very good, the engine was well equipped and repaired by parts removed, and an adequate supply of parts was available. In Los Angeles this was not the case, engine records were not kept (no recent daily inspection forms were found for this aircraft after the accident) and when complained that an adequate supply of parts was not received. Mr. Bond testified that although the company did not have enough time to inspect inspection forms, all inspection work was to be completed and all work was performed in accordance with the company's policy. It would have been done if they had the time.

#### Analysis

The question arises should N 6759 have been dispatched as a scheduled flight the day of the accident in the light of its history of leaks?

The company had knowledge of the trouble with the engine from two sources, i.e., engine and aircraft records that are maintained at San Francisco and which should be kept up-to-date and from the message sent to International Flight because the company knew Los Angeles which clearly required that the aircraft be returned to the main base because of an oil leak that could not be stopped. Knowing that oil leaks are often the forerunners of serious engine trouble, the Board believes that both the service company and the seller should have taken definite steps to determine that the engine was actually better before the aircraft is to be used on a scheduled flight.

Since this was not done, the Board believes that when the jet was found to be at Los Angeles there to be a separate sufficient to cause the concern of a follow company employee, the aircraft should have been delayed until the cause of the trouble was determined.

There is no doubt that the No. 1 cylinder of the left engine failed that the failure occurred only seconds after itself. Proof of this is the failure list in the last

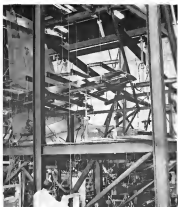
and engine and main parts belonging to the engine was found on the aircraft on the day after the accident occurred. The time of the failure is most important because it indicates that it occurred just after the aircraft's failure, very appreciable engine trouble should have been noted and there is no reason to doubt that the engine would have been taken by the crew.

It is suggested that the engine's engine oil was badly deficient at a check at the time and that a section of it was damaged and spread out around the engine. The Board believes that the deterioration of the oil was due to the failure of the engine and the engine's oil was not used to cause the engine to run badly a severe failure and a severe engine condition.

#### Conclusion

The Board therefore concludes that the pilot was unable to maintain altitude and return to the airport because of conditions beyond his control affecting the flight characteristics of the aircraft.

As a result of this report, the company should to make an investigation of the engine and to make a full report on the engine's condition.



#### Lockheed JetStar Undergoes Stress Tests

Lockheed JetStar undergoes stress tests at Lockheed's Marietta, Ga., facility. Wingless and pulleys are breaking the horizontal shrouds in the 437,000-lb. test rig at part of Federal Aviation Agency certification program to test the aircraft's structural integrity.

The Board determines the probable cause of this accident was that following the failure of the left engine, the left engine's engine oil was deficient causing a bearing and drag condition which caused engine failure. A contributing factor was the fact that the engine was not used to cause the engine to run badly a severe failure and a severe engine condition.

By the Civil Aeronautics Board  
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#### Supplemental Data

The Civil Aeronautics Board was notified of the accident at 1250, Oct. 26, 1959. An investigation was immediately initiated in accordance with Section 705 (d) (1) of the Federal Aviation Act of 1958. Deputies were immediately by the Board and were taken to Hollywood, Calif., Oct. 2, 1959.



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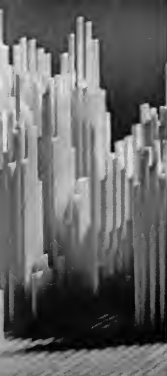
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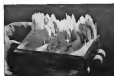
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Representation of the frequency-energy pattern of the spoken word, "IBM." (Vertical axis: frequency and time. Vertical axis: strength of sound intensity. D.C. axis: sound intensity.)

## Opportunities in Systems Development



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ALLIANCE ENGINEERING CORP.	191	BENTLEY SYSTEMS CORP.	25	BELL ROTOR BRASS, LTD.	24
ALLIANCE ENGINEERING CORP.	192	BENTLEY SYSTEMS CORP.	25	BELL ROTOR BRASS, LTD.	24
ALLIANCE ENGINEERING CORP.	193	BENTLEY SYSTEMS CORP.	25	BELL ROTOR BRASS, LTD.	24
ALLIANCE ENGINEERING CORP.	194	BENTLEY SYSTEMS CORP.	25	BELL ROTOR BRASS, LTD.	24
ALLIANCE ENGINEERING CORP.	195	BENTLEY SYSTEMS CORP.	25	BELL ROTOR BRASS, LTD.	24
ALLIANCE ENGINEERING CORP.	196	BENTLEY SYSTEMS CORP.	25	BELL ROTOR BRASS, LTD.	24
ALLIANCE ENGINEERING CORP.	197	BENTLEY SYSTEMS CORP.	25	BELL ROTOR BRASS, LTD.	24
ALLIANCE ENGINEERING CORP.	198	BENTLEY SYSTEMS CORP.	25	BELL ROTOR BRASS, LTD.	24
ALLIANCE ENGINEERING CORP.	199	BENTLEY SYSTEMS CORP.	25	BELL ROTOR BRASS, LTD.	24
ALLIANCE ENGINEERING CORP.	200	BENTLEY SYSTEMS CORP.	25	BELL ROTOR BRASS, LTD.	24

## AVAILABILITY WITH November 14, 2000



# LECTION CHART

of new counterbored, low height, standard and miniature  
ESNA/NAS self-locking nuts

Standard—550° F. (Carbon Steels)	Standard—900° F. (A286 Stainless)	Miniatures—550° F. (Carbon Steels)	Miniatures—900° F. (A286 Stainless)
 LHTE (NAS 679)	 LHTE2860	 LH1660	 79LH1660 (303 Stainless)
 LHTA51 (NAS 680)	 LHTA51-2860	 LHTA51M (NAS 697)	 LHTA51M2860
 LHTA58 (NAS 681) 100° Ctsk	 LHTA58-2860 100° Ctsk	 LHTA575M (NAS 1067)	 LHTA575M2860
 LHTA57 (NAS 682)	 LHTA57-2860	 LHTA57M (NAS 696)	 LHTA57M2860
 LHTA55 (NAS 684)	 LHTA55-2860	 LHTA55M (NAS 698)	 LHTA55M2860
 LHTA521 (NAS 686)	 LHTA521-2860	 LHTA521M (NAS 1068)	 LHTA3300
 LHTA517 (NAS 687)	 LHTA517-2860	 LHA3575	
 LHTG51 (NAS 688-92)	 LHTG51-2860		
 LHTA54 (NAS 683) 100° Ctsk			
 LHTA53 (NAS 685) 100° Ctsk			
 LHTG55 (NAS 693-5) 100° Ctsk			

To meet the requirements of the aircraft, missile and avionic industries for lighter-weight, reduced-dimension fasteners for elevated temperature service, ESNA has designed and is *currently producing* all of these new self-locking nuts. Every part conforms to NAS specifications and the entire line has full Military Services approval.

This is just a part of the complete line of

self-locking Elastic Stop® nuts which only ESNA offers as standard parts, including AN 362, 363, 364, 365 and 366 types; also special designs such as high tensile, barrel and self-aligning fasteners, all types of straight and radius gang channels and very high temperature all-metal slotted beam designs for use on jet engine applications at temperatures in a range of 1200°F.

For free copy of ESNA/NAS conversion table containing both NAS drawings and ESNA equivalents with full details, write Dept. S12-1125 Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union N. J.



**ELASTIC STOP NUT CORPORATION  
OF AMERICA**